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DISADVANTAGES OF THE UPRIGHT POSITION.

BY S. V. CLEVENGER, M.D.

THE immediate and remote causes of things have been and will be sought by thinkers who are not afraid to follow wherever facts lead them. The doctrine that there is no effect without an antecedent cause, has met with fierce opposition from those who saw that the logical conclusions of correlated facts, such as are presented by Darwin, tended to the overthrow of puerile legends they believed in, and who were content to imagine that everything was causeless, or at best originated in some inscrutable way. The Arab, upon having the sidereal motions explained to him, said, "You trouble yourself greatly about things not intended for you to know. Even though what you tell me is true, the Koran leads us to believe otherwise. Mohammed taught us sufficient, and his followers can torture you out of your rationalism. Forbear your heretical facts!"

The mechanical nature of things animate is as old in theory as Democritus, 500 B. C.; and Giordano Bruno, in A. D. 1600, for having amplified the Democritic idea, was burned at the stake. Kant granted a mechanical cosmogony, but in organic nature claimed *causæ finales*. The battle of *causæ efficientes* was fully won by Galileo, Copernicus, Kepler, Newton, Herschel, Laplace, etc., so far as the inanimate universe was concerned, but the mechanical conception of that which pertains to living things was hinted at by Aristotle. Geoffrey de St. Hilaire contended against Cuvier for the mutability of species and the monistic theory.

Treviranus, Oken, Goethe, Lamarck, and in our day, Darwin, Haeckel, Huxley, have carried on the warfare. Herbert Spencer advanced a mechanical physiology and morphology. His has carried the conception into histology, and Cope into palæontology. The unity of the laws which control organic and inorganic nature are to-day fully recognized by those who stand in the front rank of investigators and thinkers, but not until completer text-books from the new standpoint shall have found their way into the hands of medical students and naturalists generally, will common recognition of the success of the mechanical idea be obtained.

Assuredly the teleological is a very lazy way of thinking. It amounts to taking things for granted as so, because they are so. It bars all inquiry, stops all investigation, and hands us bound hand and foot to ignorance and superstition.

Mechanical influences, such as impacts and strains, permanently altering animal organs, have been discussed by Professor E. D. Cope in the AMERICAN NATURALIST, in articles entitled, Origin of the Foot Structures of Ungulates, April, 1881; Effects of Impacts and Strains on the Feet of Mammalia, July, 1881; by Alpheus Hyatt, Transformations of Planorbis at Steinheim, with Remarks on the Effects of Gravity upon the forms of Shells and Animals, June, 1882. In articles published in the January and February, 1881, numbers, I attempted a disquisition upon physical influences in their relations to comparative neurology, and in the July, 1881, number of the AMERICAN NATURALIST, On the Origin and Descent of the Human Brain, pointed out some hitherto neglected mechanical factors in the development of the organ of the mind and its osseous envelope.

While engaged in anatomical studies, the idea that there was a definite reason for everything, and that we might some day discover the reasons for many things not now known, was ever present to my mind. I could get half lights and glimpses of causes from hints in Henle, Holden, or Sharpey and Quain, and fancied I saw matters clearly enough in some particulars, only to be confused by contradictory experiences subsequently.

There seemed to be a definite enough law in the formation of valves in the veins, for instance, but every student was compelled to learn the location of these valves by arbitrary exercise of the memory. I think every student will conclude at the end of this

paper that it is easy enough *now* to remember which veins are valved and which are not. Let me present the subject just as it perplexed me at first. Nothing could be simpler from the teleological standpoint, than that we should have valves in the veins of the arms and legs to assist the return of blood to the heart against gravitation, but what earthly use has a man for valves in the intercostal veins which carry blood almost horizontally backward to the azygos veins? When recumbent these valves are an actual detriment to the free flow of blood. The inferior thyroid veins which drop their blood into the innominate are obstructed by valves at their junction. Two pairs of valves are situated in the external jugular and another pair in the internal jugular, but in recognition of their uselessness they do not prevent regurgitation of blood nor liquids from passing upwards.

An apparent anomaly exists in the absence of valves from parts where they are most needed, such as in the venæ cavæ, spinal, iliac, hæmorrhoidal and portal. The azygos veins have imperfect valves.

Place man upon "all fours" and the law governing the presence and absence of valves is at once apparent, applicable, so far as I have been able to ascertain, to all quadrupedal and quadrumanous animals: *Dorsad veins are valved; cephalad, ventrad and caudad veins have no valves.* The apparent exceptions to this rule, I think, can be disposed of by considering the jugular valves as obsolescing, rendered rudimentary in man by the erect head, which in the lemur stage depended. The rudimentary azygos valves may be a recent creation, and an explanation of their presence may be found in the mutability of the cardinal system. The single Eustachian valve, being large in the fœtus, has a phylogenetic value. In this connection I would call attention to my mention, in *Science* (New York), June 25, 1881, of the probable branchial origin of the thyroid and thymus glands. There are many reasons for believing these bodies to be rudimentary gills.

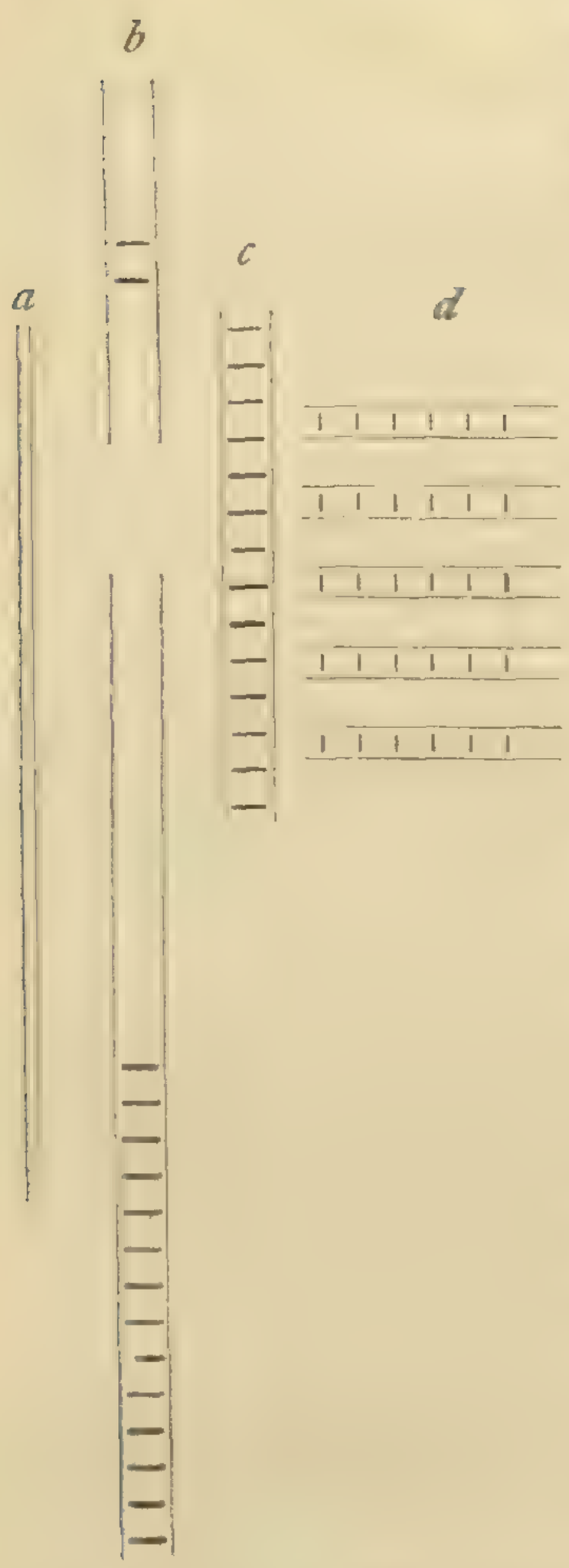
The only reason I can assign for the absence of cephalic and cervical valves generally, while the jugulars possess them, is, that the jugular system was the most important to our quadrupedal ancestors with dependent heads, hence valves developed in them, and that owing to the cranial blood-vessels developing, *pari passu*, with the cranium and its contents generally, largely after man had

assumed the erect position, the valvular formation elsewhere in the head would not occur while the jugular valves became rudimentary.

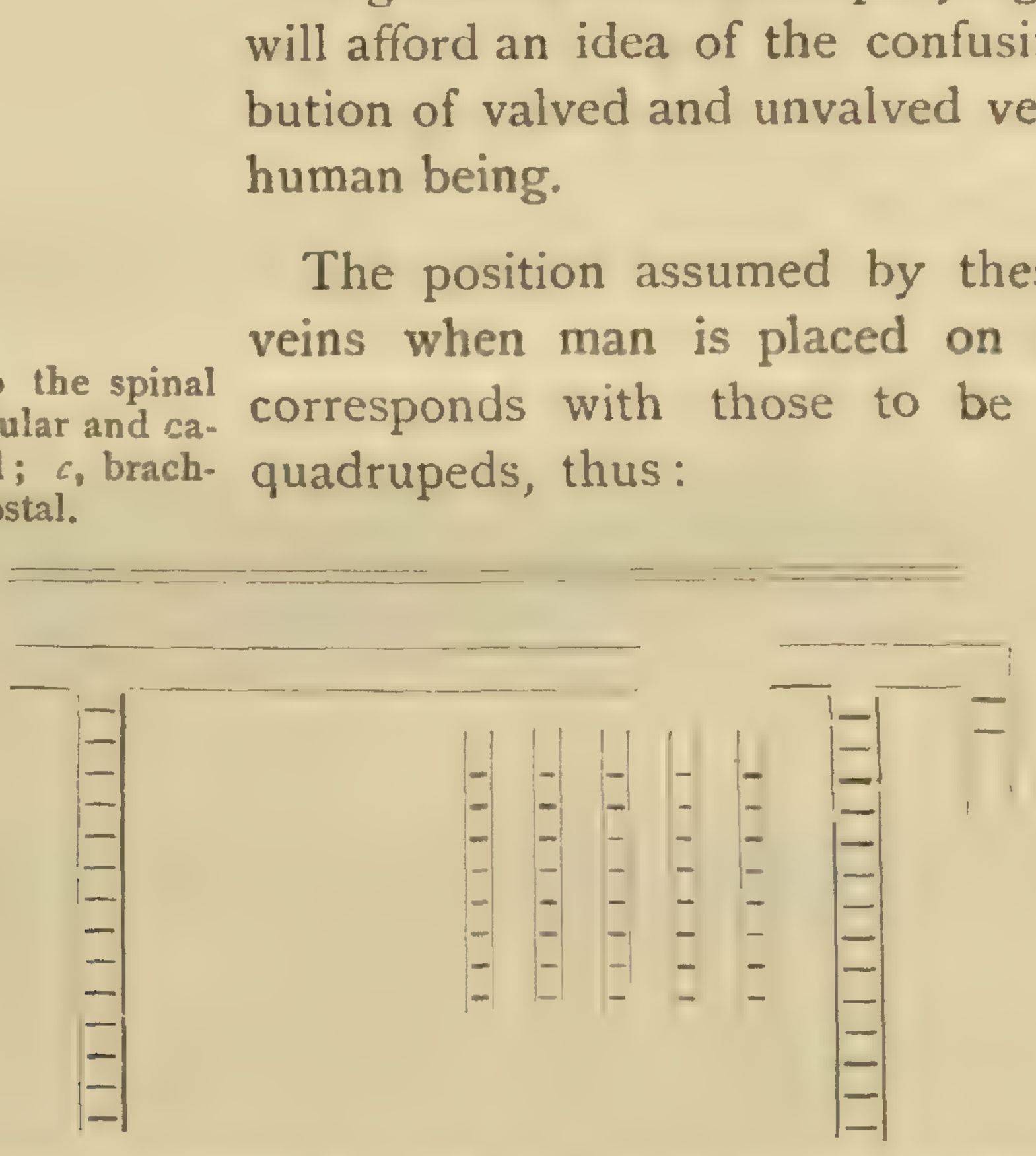
Certainly valves in the hæmorrhoidal veins would be out of place in quadrupeds, but to their absence in man many a life has been and will be sacrificed, to say nothing of the discomfort and distress occasioned by the engorgement known as piles, which the presence of valves in these veins would obviate. The spermatic valves are as useful in man as in other animals.

A glance at the accompanying diagram will afford an idea of the confusing distribution of valved and unvalved veins in the human being.

The position assumed by these valved veins when man is placed on all fours, corresponds with those to be found in quadrupeds, thus:



a, refers to the spinal system; *b*, jugular and caval to femoral; *c*, brachial; *d*, intercostal.



A noticeable departure from the rule obtaining in the vascular system of Mammalia also occurs in the exposed situation of the femoral artery in man. The arteries lie deeper than the veins or are otherwise protected for the purpose, the teleologist would say, of preventing hemorrhage by superficial cuts. From the evolutionary standpoint it would appear that only animals with deeply-placed arteries would survive and transmit their peculiarities to their offspring, as the ordinary abrasions to which all animals are

subject, not to mention their fierce onslaughts upon one another, would quickly kill off animals with superficially located arteries. But when man assumed the upright posture, the femoral artery, which was placed out of reach on the inner part of the thigh, became exposed, and were it not that this defect is nearly fully atoned for by his ability to protect the exposed artery in ways the brute could not, he too would have become extinct. Even as it is, this aberration is a fruitful cause of trouble and death.

Another disadvantage which occurs in the upright position of man, is his greater liability to inguinal hernia. Quadrupeds have the main weight of abdominal viscera supported by ribs and strong pectoral and abdominal muscles. The weakest part of the latter group of muscles is in the region of Poupart's ligament, above the groin. Inguinal hernia is rare in other vertebrates because this weak part is relieved of the visceral stress, but as the pelvis receives the intestinal load in man, an immense number of tissues are manufactured to supplement this deficiency. It has been estimated that twenty per cent of the human family suffer in this way, and strangulated hernia frequently occasions death.

If man has always been erect from creation, then we have nothing to hope from the future by way of an alteration of this defect. The same percentage of humanity will suffer to the end of time; but considered mechanically the so-called conservative influence of nature which will tend to pile up additional muscular tissue in this region by reason of the increased blood supply to that part, aided by natural and sexual selection, will eventually reduce the percentage of ruptures greatly, if it does not eventually correct the trouble altogether. The liability to femoral hernia is similarly increased by the upright position.

The peritoneal ligaments of the uterus subserve suspensorial functions in quadrupeds fully, which require much ingenious speculation to be faintly seen in man. The anterior, posterior and lateral ligaments are mainly concerned in preventing the gravid uterus from pitching too far toward the diaphragm of four-footed animals. The round ligaments are absolutely meaningless in the human female, but in lower animals serve the same purpose as the other ligaments. Prolapsus uteri by the erect position and absence of support fitted to that attitude, are thus rendered frequent, to the destruction of health and happiness of multitudes.

As a deduction from mechanical laws, it could easily be imag-

ined that an animal or race of men which had the longest maintained the erect position would have straighter abdomens, widely flared pelvic brims with contracted pelvic outlets, and that the weight of the spinal column would carry the sacrum lower down, and in general terms we find this to be the case. In quadrupeds the box-shaped pelvis, which admits of easy parturition, prevails, but where the position of the animal is such as to throw the weight of the viscera into the pelvis, the brim necessarily widens, these weighty organs sink lower, and the heads of the femora, acting as fulcra, admit of the crest of the ilium being carried outward, while the lower part of the pelvis must be contracted. This box shape exists in the child's innominate bones, while its protruding abdomen resembles that of the gorilla. The gibbon exhibits this iliac expansion through the sitting posture, which developed his ischial callosities. Similarly iliac expansion occurs in the chimpanzee. The Megatherium had wide iliacal expansion, due to its semi-erect habits, but as its weight was mainly supported by the huge tail with femora resting in acetabula placed far forwards, the leverage necessary to contract the lower pelvis is absent. Professor Weber, of Bonn, noted by Carl Vogt, "Vorlesungen über den Menschen," etc., distinguished four chief forms of the pelvis in man: the oval, round, square and cuneiform, owned in order by Europeans, native Americans, Mongols and black races. Resting upon its own merits as an osseous mechanical proposition, it would seem that the older the race the lower the sacrum and the greater the tendency to approximate the larger transverse diameter of the European female. The antero-posterior diameter of the simian pelvis is usually greater than the transverse; a similar condition affords the cuneiform, from which could be inferred that the erect position in the negro races had not been so long maintained as by the Mongols, whose pelvis assumed the quadrilateral shape owing to persistence of spinal axis weight through greater time; this pressure has finally culminated in pressing the sacrum of the European nearer the pubes, with consequent lateral expansion at the expense of the antero-posterior or conjugate. From Marsupialia to Lemuridæ the box shape pelvis persists, but with the wedge shape induced in man a remarkable phenomenon also occurs in the increased size of the fœtal head in disproportion to the contraction of the pelvic outlet. While the marsupial head is about one-sixth the size of the

smallest part of the parturient bony canal, the moment we pass to erect animals the greater relative increase is there in the cranial size with coexisting decrease in the area of the outlet. This altered condition of things has caused the death of millions of otherwise perfectly healthy and well-formed human mothers and children. The palæontologist might tell us if some such phenomenon of ischial approximation by natural mechanical causes has not caused the probable extinction of whole genera of vertebrates. If we are to believe that for our original sin the pangs and labor at term were increased, and also believe in the disproportionate contraction of the pelvic space being an efficient cause of the same difficulties of parturition, the logical inference is inevitable that man's original sin consisted in his getting upon his hind legs.

Something of the changes noticed in the angle at which the head of the femur is set upon the shaft at different ages, is also noticeable phylogenetically. The neck of the femur in the child is obliquely placed, but in the adult is less so, and in advanced age tends to form a right angle with the socket. Both in the advance of age in the individual and the tendency of an animal to assume more and more the upright posture, this change of angle seems attributable to no other cause than bodily weight against the femoral heads.

This subject is not without direct application. Gynæcologists cause their patients to assume what is called the knee chest position, a prone one, for the purpose of restoring uteri to something near a natural position. Brown-Sequard recommends drawing away the blood from the spine in myelitis, or spinal congestion, by placing the patient on his abdomen or side with hands and feet somewhat dependent. The liability to spina-bifida is greatest in the human infant through the stress thrown upon the spine, and the absence of delivery troubles among lower races have reference to discrepancy between pelvic and cranial sizes not having been reached by those races. The Sandwich island mother has difficult delivery only when her progeny is half white, that breed being larger in the forehead than the native child.

The mechanism of the body, when fully recognized as mechanism and nothing else, and as governed by mechanical laws, physical as well as chemical influences, will place forthcoming physiological studies upon a broader, safer foundation, and result

in grand generalizations. The hydro-dynamics of animal life would alone furnish a theme for thousands of investigators. At present the world goes on in its blindness, apparently satisfied that everything is all right because it exists at all, ignorant of the evil consequences of apparently beneficent peculiarities, vaunting man's erectness and its advantages, while ignoring the disadvantages. The observation that the lower the animal the more prolific, would eventuate the belief that the higher the animal the more difficulties encompass his development and propagation, and the cranio-pelvic incompatibility alone may settle the Malthusian doctrine effectually for the higher races of men through their extinction.

FOOT-NOTE.—This article has a little history of its own, the nature of which shall be its excuse for publication here.

Some members of the Chicago University faculty asked me, last year, if I would accept the chair of Comparative Anatomy and Physiology in that institution. I replied that I would, but must be allowed to teach what I considered to be the truth, and that evolution was the only sensible basis for such instruction. The president of the faculty, a Baptist minister, was to call upon me, I was told, upon a certain day to arrange concerning salary and minor details. April 18, 1882, by invitation, I lectured before the Chicago University Club on the Disadvantages of the Upright Position. The subject and its treatment proved too Darwinistic, as a foretaste of my teachings, and the president did not call to see me. Since then Professor E. S. Bastin, who had ably filled all the scientific chairs in the university, was found to be teaching strict truth, to which no objection was raised, but the *effects* of such teaching upon the minds of the students was found to interfere with their docile gulping of all the antiquated rubbish dealt out from other chairs. A "safe" teacher was wanted, one who could use the text-books of last century's science. Professor Bastin resigned.

Another "university" hereabouts made the substitution of Egyptian mythology for botany optional in the classical course.

These tottering schools do not seem to have asked themselves why a half million people fail to support them, nor to be aware that Eastern colleges are filled with Western youth, who might as well be taught nearer their homes the branches they can learn only in other States.

The Academy of Sciences in this city has never recovered from the disaster of the great fire. The building has been forfeited through debts; large and valuable collections are being donated to it by Eastern institutions, but remain boxed up and unused. The last lecture I attended there was by a reverend gentleman whose thesis was the impossibility of the river Nile being more than 6000 years old. He based his calculations upon ten years' observations of the alluvial deposit at the mouth of a small creek in this State. Darwinism mentioned within these precincts has something of the effect of the red rag shown to the bull, though no objection has been raised against the delivery of evolutionary lectures.

The few scientific men Chicago has originated are drifting away from the place. Gigantic barter occupies the time and attention of the people exclusively. It will

probably be five hundred years before abstract science can be supported here, from present indications.

This paper has been withheld from publication three years, as I earnestly desired to make full dissections of widely diverging genera, to fully corroborate the general law which may be said to have been arrived at both inductively and deductively. The pathology of insanity now claims my entire time, and I must leave to others the completion of what I have begun.

There have been occasional passages in medical journals which bore upon the subject of the significance of valves in the veins, but I believe that no one has anticipated me in the announcement of the influence which gravitation exerts upon the creation of these valves in quadrupeds, and that man's veins are valved in such manner as to place his derivation from a quadrupedal form beyond dispute. The deductions from mechanical influences made in this paper are original, and I cannot find that they have been elsewhere mentioned. Certainly the publication of so sweeping a statement as that pertaining to the valves would have attracted universal attention among comparative anatomists had it been made before, and eminent gentlemen in that field have confessed to me that the matter was new to them.

Besides its reading before the University Club, April 18, 1882, the substance of this paper was presented by me before the Philadelphia Academy of Natural Sciences last May, as noted in AMERICAN NATURALIST, September, 1883.

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THE MAMMALIAN FAUNA OF THE AUSTRALIAN DESERT.

BY EDWARD B. SANGER.

THE physical conditions of the interior of Australia are not such as to support a varied fauna. The mammals are few in number, and are principally those which are best adapted for dry and arid regions. But four orders of Mammalia are represented, viz: Cheiroptera, Rodentia, Carnivora and Marsupialia. The first named order is represented by *Scotophilus moris*, the chocolate bat. These animals are very numerous. They live in hollow trees, and fly around in great numbers about dusk. To the natives, who catch and eat them, they are known by the name of "*oolowarra*." They are generally caught by chopping them out of the hollow trees in day time. This is the only species of bat that I observed in the interior. The Rodentia are represented by three genera and five species, viz: *Hapalotis conditor*, *H. mitchelli*, *H. cervina*, *Mus vellerosus*, *Hydromys fulvolovatus*.

Hapalotus conditor is the Australian building rat. It builds nests, among the sandhills near the creeks, of sticks, leaves, &c. The nest is very roughly constructed, and to a non-observing eye looks like a mere bunch of dry sticks. Inside it is lined with soft leaves and bits of grass. The entrance is a small hole on the

side. There is another mode of ingress or egress afforded by a tunnel burrowed by the rat from the floor of the structure underground to a distance of about three feet, when it rises to the surface in some clump of grass or small bush. This is evidently a mode of escape for the animal when surprised by aborigines or dingos (*Canis dingo*), which seem to be their only enemies. This rat is called "*kuckala*" by the natives, who prize them exceedingly as food.

H. mitchelli and *H. cervina* are both nocturnal jerboa rats. Their nests consist simply of a few leaves and bunches of grass raked together in some clump of bushes. The natives eat them and call them respectively "*arritchi*" and "*koolahroo*."

Mus vellerosus is a small rat which infests large tracts of country in droves during flood time. They migrate from place to place. Their well-beaten paths may often be seen winding through the sandhills, and sometimes the droves themselves. They are a great nuisance to the whites, as they eat up everything. Saddles, provisions and everything that can be hurt by an animal's teeth must be placed up in trees or stumps away from the ground when the nightly camp is made, or all will be destroyed before morning. The native (Dieyerie) name for them is "*miaroo*."

Hydromys fulvolovatus, the large Australian water rat, is common in all the prominent water holes on Cooper's creek. They live in holes in the banks, with one entrance opening under water and the other on the land. They live principally on roots, &c. The natives say that they kill and eat various water birds. I cannot say whether this is true or not, but I know that they will eat flesh. One day I shot some black swans (*Chenopis atrata*) and left them, after securing the skins, on the bank of a water hole. The next day I went there, and as I approached the dead swans I saw two or three water rats run away from them and disappear in the water. The swans were half eaten up, and had been dragged several yards nearer the water. I determined to make sure whether the rats had eaten of them or whether it was the dingos. I seasoned them with some strychnine and the next day found two dead rats by them. I think it is very probable that they do catch and eat birds. They are very large and ferocious, and can bite severely. The natives are afraid of them.

The Carnivora are represented by *Canis dingo*. This dog is

abundant wherever there are any animals for it to prey upon. Hence in regions where there are cattle and sheep they are more numerous than in outlying districts. The settlers poison them by preparing baits treated with strychnine.

They do not travel or hunt in packs, but are solitary. Neither have they any fixed nest or den. In settled districts they are very shy, as might be expected; but in the remoter parts they are bolder, and I have known them carry off my boots at night time, which is very inconvenient in such regions. They are orange-yellow in color, and have a large bushy tail. In fact they are very handsome when pure blooded, *i. e.*, have not mixed with other dogs belonging to the whites. They make a very mournful noise, howling at night. I have never heard the wild ones bark; they howl and growl only. They eat any animal that they can catch, lizards even. The smaller and more sluggish animals are the ones which fall a prey to them, as the dogs are no match for the kangaroo or wallaby in swiftness; indeed, an adult kangaroo can easily kill them, so the dogs wisely leave them alone. It is very amusing to see one twisting and turning in pursuit of a sandhill wallaby (*Bettongia grayi*); the dog is generally beaten in the race. Sometimes, however, when the dog catches the wallaby napping, the laugh is on the other side. The natives tame these dogs and always have a great number of them around their camp. Though they are kept in a half-starved condition, the natives seem to be fond of them.

The dingos interbreed with dogs introduced by the whites. So common is this, indeed, that in the more settled districts a pure-blooded dingo is a rarity. They are universally distributed, being found in all parts of the continent, and do not seem to vary in character at all. The natives have no traditions concerning them, as far as I was able to learn.

The Marsupialia of the desert are represented by three families, viz: the Macropidæ, Peramelidæ and Phalangistidæ. In the first-named order the largest form found in the desert is *Osphranter rufus*, the common red kangaroo. The male is red and the female bluish-gray. This animal is but rarely seen, and only after a heavy rain, when there is plenty of vegetation for it to feed upon. Towards the confines of the desert it is more numerous.

Onychogalia lunata, the crescent-marked, nail-tailed kangaroo, is also rather uncommon, and is almost always found on the stony plains or tablelands.

Bettongia grayi, Gray's jerboa or the sandhill wallaby, is found among the sandhills, and is solitary in habit. I never saw two of them together. It is very swift and dexterous, dodging in and out among the bushes in a surprising manner.

Among the Peramelidæ we find *Peramcles fasciatus* and *Peragalea lagotis*, known respectively as the banded and the long-eared bandicoot. Both of them are found in the sandhill country.

Chœropus castanopus is also found, but it is rare.

Along the creeks, and especially where there are abundant water holes, phalangers (Phalangista) are abundant, but of what species I am uncertain.

The above are all the mammals that I met during my two years' sojourn. When the country is better known more will probably be found. The number of forms depends greatly on the character of the season. After a rain animals visit the desert that are not known there at other times. Hence the conflicting reports received so often on the subject. With the exception of *Osphranter rufus* those mentioned above are true desert forms; that is, they are always found there. It is worthy of note that the Marsupialia, though furnishing the greatest number of species, are not the predominating order of mammals. The Rodentia preponderate in number and almost equal the former in species. This is a notable exception to the other parts of the continent. It is still more interesting to notice that two (the jerboas) of the four species of Rodentia remarkably resemble certain forms of the Marsupialia. Like physical conditions seem to tend to produce similar forms out of different types of animals. In other parts of the continent certain marsupials have developed into carnivores curiously resembling some forms among monodelphian Carnivora.

The mammals living at present in the desert are small, and are well adapted to the life they lead. When contrasted with the giant marsupials which once inhabited the region, and whose remains we now find here and there in it, we can see how much the character of the fauna depends on the constancy of the physical conditions of the region. Slight changes produce great results.

OBSERVATIONS ON THE PULSATING ORGANS IN THE LEGS OF CERTAIN HEMIPTERA.[1]

BY WM. A. LOCY.

CONFLICTING opinions have been held regarding the pulsating organs that have, from time to time, been observed in the legs of certain Hemiptera.

They were first drawn and described by Behn, in 1835. These observations were at once called into question by Léon Dufour, who at that time was the acknowledged autocrat of the anatomy of the Hemiptera.

Dufour considered that these movements were due to contractions of the ordinary muscles of the legs and denied the existence of the blood currents observed by Behn. The scientific value of Dufour's opinion on this point loses its force on account of his well known hostility to the theory of circulation of the blood in the Insecta.

In the summer of 1883, while working on the circulation of blood in the Hemiptera, these organs came under my notice, and the following is a simple record of observations made to determine:

(1) Whether these organs are distinct from the muscular system of the legs, and

(2) Whether they influence circulation?

To both of these questions the evidence is for an affirmative answer. During the progress of the work their automaticity was also observed and well established.

Methods.—Different genera of the aquatic Hemiptera were fastened upon a microscope slide, their legs spread out in glycerine and covered with a cover-glass. The legs thus prepared were studied with both low and high powers of the microscope. Specimens for examination were chosen with reference to the transparency of their legs, as it is upon this point that success of observation depends. Both larval and adult forms of the genera studied were used, but the best results were uniformly obtained with the larval forms, on account of the greater transparency of their legs.

In some cases special methods were necessary to render the legs transparent enough for observation. For this purpose the

[1] Work from the Biological Laboratory of Mt. Morris College, Mt. Morris, Illinois.

integument of the legs was scraped very thin. The organs can be demonstrated in this manner, even in the thick legs of the adult Belostomæ.

The organs are most easily seen in the legs of Notonecta and Corixa, but are not so large and pronounced as in the legs of the Nepidæ. In the more transparent individuals not only are the organs readily seen, but the circulation of the blood can be watched with a power high enough to bring out the corpuscles.

The pulsating organs were noted in the following genera: Corixa, Notonecta, Gerris, Belostoma, Perthostoma and Ranatra; particular attention having been given to the organs in Belostoma, Perthostoma and Ranatra.

Description.—These organs are found in the three pairs of legs of all the genera mentioned above. They are generally in the tibia of the leg, just below its articulation with the femur. In the raptorial legs of Ranatra, however, the organs are in the clasp-joint or tarsus just below its articulation with the tibia.

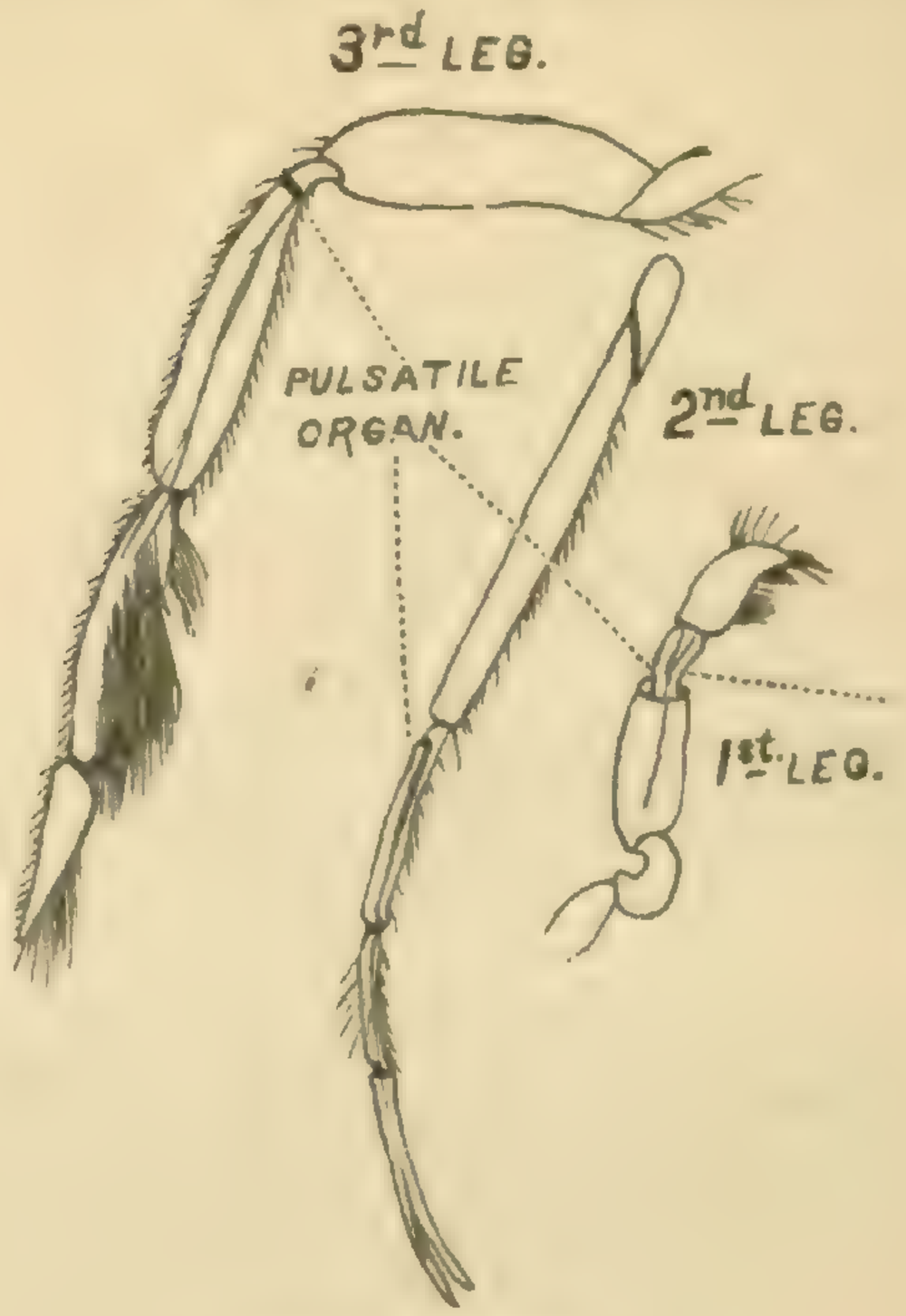
Examined with a power of seventy-five diameters, they appear as little whip-like organs pulsating rapidly. In the Nepidæ they lie outside the median line of the leg, towards the front side, being slightly convex towards the outside. This curved body which forms the bulk of the pulsatile organ, is attached at both ends and from its sides several attachments extend upwards and backwards to the integument of the leg (see Fig. 4).

The shape in Corixa and Notonecta is quite different; it is somewhat hand-shaped in Notonecta, and in Corixa the shape of an inverted letter L, with its lower portion prolonged. This hangs down into the leg-cavity beyond the median line.

Crossing these organs obliquely, in the Nepidæ, lie the muscular fibers of the legs. The bands of muscle appear either straight or wavy, according as the legs are bent or extended, and remain perfectly quiet while the organs are beating. A careful study of the muscular system of the legs was first made, to avoid confusing it with the organs in question. With a power of 150 diameters it can be made out very satisfactorily that the pulsatile organ is a thing separate from the muscular fibers of the leg, and does not involve them in its motion. This is best seen by focusing back and forth. When we have the muscles clearly in focus, the movements of the pulsating organ can still be seen lying a little out of focus. In some of the thick-legged specimens, where a dis-

FIG. 1.

FIG. 2.



PULSATILE ORGAN.

FIG. 3

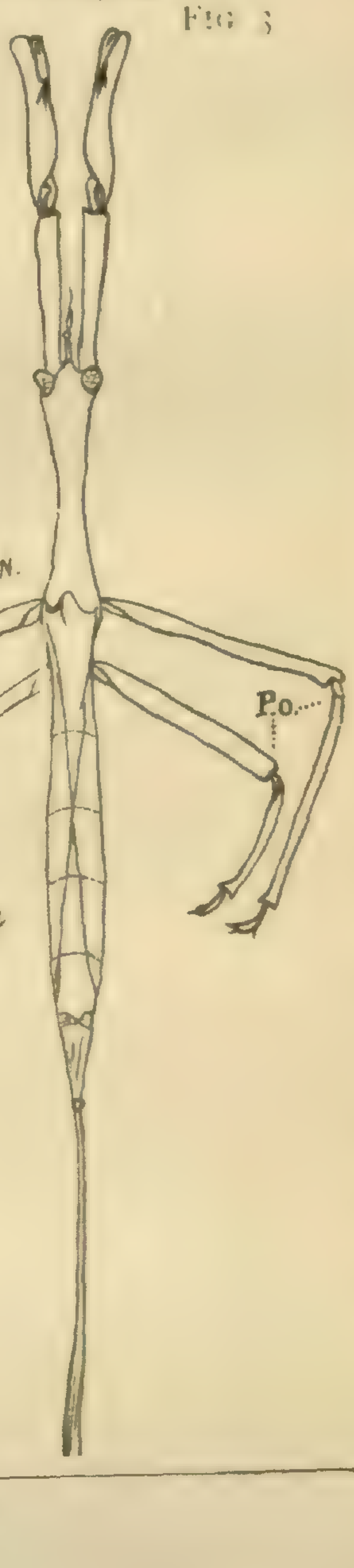


FIG. 4.

PULSATILE ORGAN.

PULSATILE ORGAN.

PULSATILE ORGAN.

tinct focus could not be obtained, the pulsations seemed to involve the muscular fibers, but scraping the integument thin, so as to admit more light, showed that this appearance was due to the general indistinctness.

The pulsating organs are also unaffected by the movements of the muscles of the legs. On several occasions, when the legs were moving back and forth and the muscles all in action, the pulsatile organ has been observed beating naturally, wholly unaffected by their movements.

Influence upon circulation, etc.—In studying the influence of these organs on circulation, they were observed with powers of the microscope ranging from 187 to 438 diameters. Either of these powers is sufficient to bring out the blood corpuscles.

In the legs of the insects in question there are two blood currents, an outgoing current and a returning current. The outgoing current passes along the inside of the leg, below the pulsating organ, and the returning current passes to the outside of the leg, above the pulsating organ. As the blood currents flow near the pulsatile organ they move faster, and around the organ itself there is a whirlpool of motion. Here the corpuscles can be seen rolling over and over one another, and striking against the pulsatile organ, by which blow they are driven whirling along their course.

The beating of these organs in the Nepidæ is such as to aid circulation in both directions; and of their influence over it there is abundant proof. The motion of the pulsating organ is difficult to analyze and describe. In an organ beating slowly the motion is seen to originate in the posterior end, spread wave-like forwards to about the middle of the organ; the anterior end simply rising and falling. It may be likened to the motion of a whip-lash, resting on the ground, when the stock is given a quick upward stroke. It is to be understood that the "anterior end" means the end towards the head of the insect, and the "posterior end" the one opposite, towards the extremity of the leg. The attachments have no movement of their own, but are set in motion by the organ. This motion in the rapidly-beating organ resolves itself into an upward beat of the posterior end almost simultaneous with a downward stroke of the anterior end. Such an arrangement would aid the circulation of the blood. As the posterior end beats upward, it would make room for the outgoing cur-

rent and, at the same time, force along the returning current. The outgoing current would almost instantaneously receive an impetus from the downward stroke of the anterior end.

The influence of the pulsating organ on circulation is shown, not alone by the energetic movements of the blood currents in its vicinity, but also when the motion ceases in it the blood currents stop. I have never observed circulation in the legs while these organs were quiet; nor have I failed to detect it when they were in motion, except in a few specimens too opaque to show the blood corpuscles. The stopping and commencing of the blood currents, induced by the pulsating organ, have been repeatedly observed. As soon as the pulsatile organ stops, the blood currents immediately cease in that particular leg, and the first motion of the blood is a slow retrograde movement which is particularly noticeable around the pulsatile organ, since here the corpuscles are thickest. A slow oscillation sometimes takes place, similar to the movements in a frog's capillaries, when circulation is suspended in the web. With the first stroke of the pulsatile organ, circulation is resumed, and continues until the pulsatile organ again stops.

The influence of each pulsatile organ is confined, as near as I can make out, to a single leg, as circulation was noticed in progress in the body and in other legs during its cessation in one leg.

In their intermittent action the periods of rest are comparatively short and independent of each other. Their periods of rest sometimes correspond, however, and the pulsatile organs of one side of the body may all be in a quiescent state at the same time.

My observations on the rate of beating of these organs are fragmentary, but, as far as they extend, they show that while considerable irregularity exists in this regard, the rate of the pulsatile organ is always faster than the rate of the heart in the same insect. For instance, in Belostoma where the heart beats were from thirty-four to forty-five per minute, the pulsating organs were beating from 127 to 150 times per minute. In Notonecta, where the heart was regular at seventy per minute, the pulsatile organs were beating 170 to 216 times per minute. In Ranatra the pulsations were several times counted as high as 175 per minute. These insects were too opaque to admit of counting the heart bearts.

Observations on Amputated Legs.—A strong proof that the pulsatile organs are separate from the general muscular system of the legs, is found in their automaticity. About twenty-five observations have now been made with the amputated legs of Ranatra and Perthostoma to study this phenomenon. When an amputated leg is placed under observation, the pulsatile organ is seen in motion similar to its action during life. It has already been noted that the pulsations are somewhat intermittent in life, and this characteristic is usually aggravated after amputation, so that the stops are more frequent and longer continued than before amputation.

These observations are not complete enough to establish the limit of automaticity. In one instance, however, I traced the beating of the pulsatile organ in the amputated leg of an adult Ranatra through a period of twenty-six hours and twenty minutes. The duration of beating in an amputated leg is probably greatly affected by circumstances, and it may, therefore, continue longer than in the case just cited, or stop sooner, according to circumstances.

The pulsating organ continues its beating even when sliced portions of the legs are used instead of whole legs. It was cut in two, and the posterior part, which was attached to a fragment of the leg, still continued to beat.

One set of observations on an amputated leg, that fairly represents the others, is given below in detail:

On Oct. 3, 1883, the front leg of an adult Ranatra was put under observation at 1.45 P. M. The pulsations were regular from 135 to 140 per minute. After watching for ten minutes the leg was cut off close to the body with a sharp razor. During this operation the eye was kept upon the pulsating organ through the microscope. The only perceptible effect was a slight increase in the rate of beating, which was now found to be 146 per minute. For the next ten minutes the amputated leg was under constant observation. It continued beating during this time, towards the close at a slightly diminished rate, say 135 pulsations per minute. At 2.05 P. M. I was called away.

The next observation was made after an absence of one hour and thirty minutes, at 3.35 P. M.; the organ was then beating regularly at 115 pulsations per minute. No change was observed up to 3.45 P. M., at which time the specimen was laid aside.

From 4.20 P. M. to 9 P. M. seventeen distinct observations were made, varying from one to seven minutes each. The actual time spent at the microscope during this period was forty-five minutes. For four minutes of this time the organ had been quiet.

After 5.20 P. M. it gradually fell from 103 pulsations per minute to 43 per minute, at 8.30 P. M.; from this time it began an increase that had reached 116 at 8.55 P. M.

From 9 P. M. to 10.30 P. M. forty-seven minutes were spent at the microscope, divided among thirty-six observations, the pulsations during this time gradually falling from 120 per minute to 50 beats per minute.

At 10.50 P. M. I retired, leaving the organ beating at 50 per minute.

The following morning, Oct. 4, 1883, at 6.50 A. M., the organ was not beating. At 9.50 A. M. regular observations were again commenced, and up to 1.27 P. M. twenty-nine distinct observations had been made, occupying thirty-eight minutes of actual study. The rate varied from 67 to 24 beats per minute, being the greater part of the time at 55 per minute.

No sudden transition of rate was observed in this specimen; the fall from 67 to 24 taking place gradually, the lowest limit having been reached, the rate would again increase to the high limit. Hot air blasts were several times blown over the microscopic slide after the organ had been beating twenty-one hours. The usual effect was to increase the rate and strength of beating for a short time.

The other observations do not differ in any essential particular from the one given above. They were all made in less time, however; the longer ones being several hours shorter than the one detailed.

The automaticity has also been noted in the amputated legs of Notonecta and Corixa.

The work on the histology of these organs has yielded, as yet, no definite results.

To conclude, then, in my estimation the three points mentioned at the outset have been established, viz:

(1) The pulsatile organs are separate from the muscular system of the legs.

(2) They influence circulation.

(3) They are automatic.

EXPLANATION OF PLATE I.

FIG. 1.—Belostoma larva, to show the location of the pulsatile organs. In all three pairs of legs they are in the tibia, just below the articulation with the femur.

FIG. 2.—Location of the pulsatile organ in the legs of Corixa. In this genus the chitinous cord, to which the pulsatile organ seems attached, is set in motion by its beating. The motion of this cord sometimes extends through three joints.

FIG. 3.—Ranatra, adult, to show the exceptional position of the pulsatile organ in the fore legs.

FIG. 4.—The pulsatile organ as seen in the tibia of an adult Ranatra. At the posterior end are seen the attachments extending upwards and backwards to the integument of the legs. Crossing the anterior end and middle portion are the oblique muscular fibers of the legs. The tracheæ are plainly shown. The arrows indicate the direction of the blood currents.

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ON THE CHARACTER AND FUNCTION OF THE EPIGLOTTIS IN THE BULL-SNAKE (PITYOPHIS).[1]

BY CHARLES A. WHITE, M.D.

AMONG the more commonly known serpents of the United States there is a group of species which naturalists range under the generic name of Pityophis, and which are distributed from the Atlantic to the Pacific coast. To all these species the popular name of bull-snake is applied, and the more common eastern variety is also often popularly called the pine-snake. They are great, good-natured fellows, always getting out of man's way when they can, but occasionally, if they are pressed, they will throw themselves into a somewhat threatening attitude and emit a peculiar hiss. The old naturalist, William Bartram, spoke of it as a "terrible hiss, resembling distant thunder," but even with the popular dislike to serpents, I think few persons would regard the hiss of the bull-snake as at all terrible or thunderous.

Baird and Girard, Cope. and Yarrow, have all published lists of species of Pityophis. Baird and Girard enumerated seven species; Cope, five species, dividing one of them into three varieties; and Yarrow four species, dividing one of them in two varieties.

All these forms have similar habits, and all, at times, produce a similar hoarse, hissing sound. It is well known that a hissing sound is produced by other serpents as well as other animals; but the hiss of the bull-snake has a peculiar hoarseness which is sometimes so loud that, with the help of the imagination, it appears to have

[1] Read before the Biological Society of Washington, October, 1883.

suggested a likeness to the low, rumbling bellow of the bull; hence the popular name of these serpents. The peculiarity of the hiss of the bull-snake is due to the character and posture of the epiglottis. This organ is absent, or represented only by a small tubercle, in all other serpents which I have examined. It is present in all the species and varieties of Pityophis. It is of the same general character in all, although it varies a little in shape in the

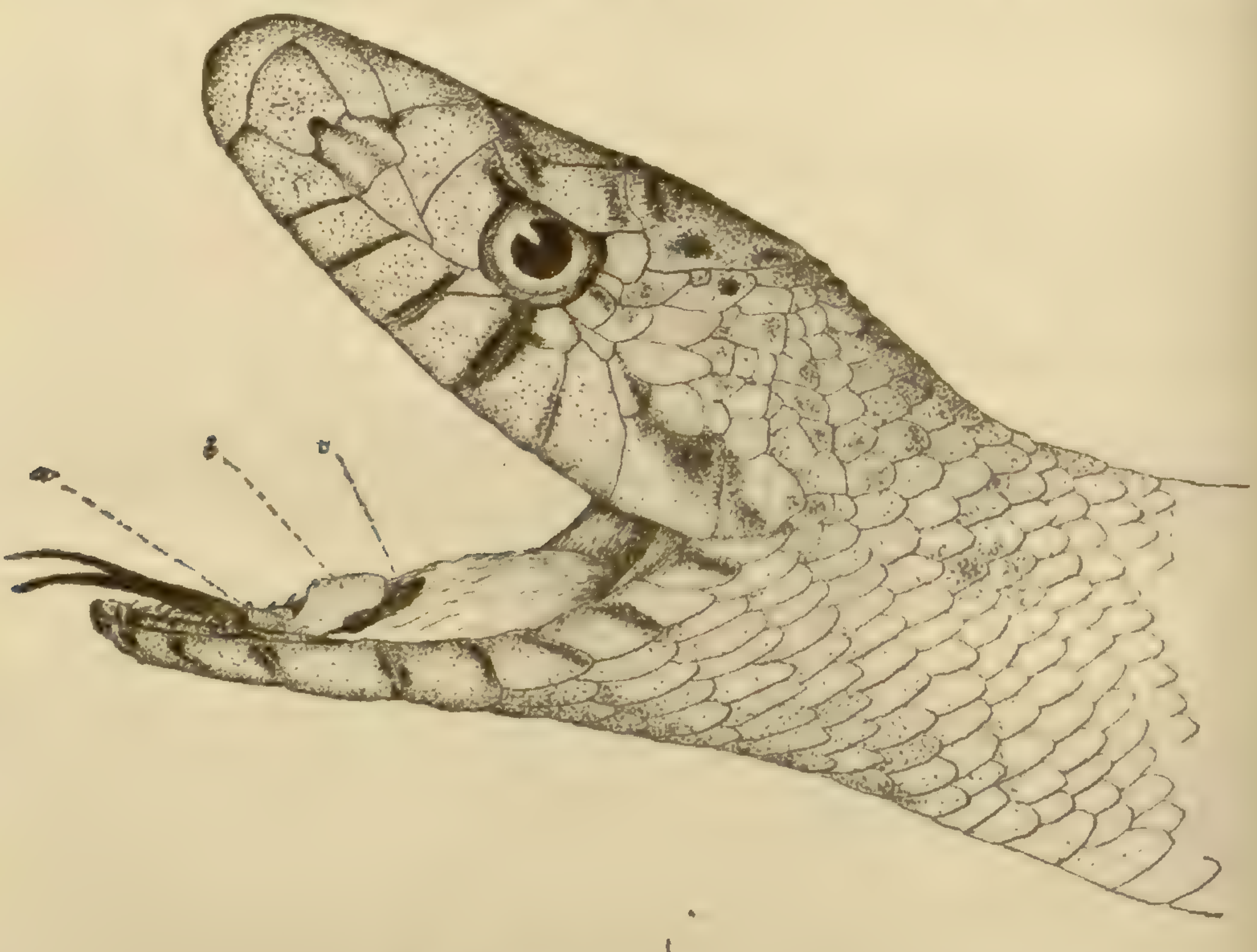

FIG. 1.—Lateral and view from above of Mouth Parts of the Bull Snake.

different species, and also somewhat in different individuals. I therefore regard this feature as a generic character, although it is not improbable that some of the nearer allies of Pityophis will be found to possess a similar epiglottis. The accompanying figures, drawn from nature by my friend Dr. R. W. Shufeldt, U. S. Army, represents the mouth-parts of *Pityophis sayi* var. *bellona*. The

tongue-sheath is represented at *a;* the epiglottis at *b;* and the rima-glotidis (aperture of the windpipe) at *c*.

The epiglottis is a thin, erect, flexible, flag-shaped or curved-spatulate body, situated upon the median line immediately in front of the rima-glotidis, and with its free end directed upward and backward, its posterior edge curving partly over the rima. It is evidently this epiglottis that produces the hoarseness of the hissing sound, which it accomplishes by dividing, and fluttering in, the strong current of air which is forced from the lung out of the rima.

That this peculiar body is really the homologue of the epiglottis in the higher animals, is shown by its position in relation to the other parts of the mouth. It differs from the epiglottis in those animals by being placed longitudinally instead of transversely, and in not being hinged, and therefore not capable of falling down to cover the rima in the act of swallowing. As serpents' food is not comminuted, but swallowed whole, such protection to the rima is unnecessary.

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THE CAROLINA WREN; A YEAR OF ITS LIFE.

BY CHARLES C. ABBOTT, M.D.

EARLY in the morning of Sept. 1, 1882, as I was passing near the stable, my attention was called to the shrill notes of an excited little bird that, darting from the building, alighted on the fence near by and screamed *Jimmée, Jimmée, Jimmée*, so loudly, that every James in the township should have hastened thither. No response came, and again the call, a clear, penetrating whistle, was repeated. This continued, at brief intervals, for two or three minutes, and then, as quickly as it came, the bird flew back to the stable, entering through a knot-hole in a weather-board with such rapidity of movement that I could but marvel at its dexterity.

Half an hour later I saw this same bird again, coming from the stable through the same knot-hole, and this time it sang as loudly, impatiently and frequently as before, but the notes were different. It said, or seemed to say, *tsau-ré-ta, tsau-ré-ta, tsau-ré-ta.* Had I not seen the bird I should have recognized it by a peculiarity in its song, which was never wanting whatever might be the particular notes it uttered. My attention being called to this little bird—the Carolina wren (*Thryothorus ludovicianus*)—I deter-

mined forthwith to study its habits, as opportunity presented, for the little that I find recorded of it is far from satisfactory.

What might be the attraction in the stable was my first object to determine, for I did not suppose it had a nest so late in the season, and I had not noticed the bird particularly du summer months, although I knew they were in the ne hood. A protracted search failed, indeed, in finding a but while I was wandering about I was surprised to see the wren enter the building and proceed immediately to search for spiders, which hitherto were abundant in every nook and corner, but now were comparatively scarce. Once the bird alighted upon the back of a horse standing in its stall, and while there quietly preened its feathers, as much as a wren ever deigns to do this, and then with a shrill chirp, that startled the animal, away it flew in search of more spiders.

Late in the afternoon of the same day I again saw the wren enter the stable and pass directly through the mow-hole to the hay-loft overhead. I followed and found that the bird had taken possession of a barn-swallow's nest, and here it was keeping bachelor's hall. The nest was placed against a rafter, near the peak of the roof, and was quite inaccessible to cats. This probably the wren did not consider. It is a sly cat that ever catches a wren napping. The bird did not like my discovering his hiding place, or at least was annoyed by my inquisitiveness. It circled about me several times, snapping its beak I thought, and chirped an unusually emphatic *tsip*, which I took to be the wrennish for "damn."

All through the mellow September days, early and late, the clear notes of this wren were to be heard, and through October, and long after every summer songster had departed, I heard them daily and many times a day.

During the autumn there was little to note with regard to the bird's habits. The insects in the stable and outbuildings afforded it a sufficient food supply, but during exceptionally warm and sunny days it made frequent visits to a wooded slope near by, and there, among the giant oaks and chestnuts, it seemed more lively and full of song than when nearer home.

A few words with reference to the character of its song. Every utterance is sharply defined by a peculiarity that belongs only to this bird. I think I should know the bird, by its voice, wherever I might hear it.

Again, while the bird has a great variety of notes, I believe I have never heard it mingle these various utterances. It may chance to whistle *jimmée* or *tsau-ré-ta* or *phoé-do*, but it never follows one with the other. It is in all cases a repetition of the notes it first utters. Thus I once recorded its song as uttered during ten minutes. Its notes then were *phoédo, phoé-do, phoé-do phée!* with a rest of some five to ten seconds; then repeated, and this continued without any variation until the notes as here given had been uttered sixty-four times. As the bird was about commencing the sixty-fifth repetition it was frightened and flew off. A half hour later the bird took up its position on a hop-vine pole and sang the notes represented by the syllables *tsau-ré-ta* forty-seven times, with intervals of about five seconds between each utterance.

I find it very generally stated that this wren is a "mocker," imitating many of our common songsters. Evidences of this have never come under my notice. Carefully as I have listened to this wren for a year, I have never heard a note that I should consider as not its own, and not borrowed. It is not safe, however, to conclude that it does not mimic other birds, because the one I have studied failed to do so. One's observations must cover a wider range of territory, and extend over many years, before it is safe to be positive in the matter of the habits of birds. Only recently I read a most painful account of the many dangers to which birds nesting in the valley of the Hudson river are exposed. According to the writer but very few broods are successfully reared. Happily, here in the Delaware valley the birds are more fortunate, and a failure is the exception, not the rule. So, too, it may be with the songs of birds. My Carolina wrens do not mimic, but perhaps my neighbor's do.

At the onset of winter, which in 1882 was late in November, the wren seemed unusually active, and sang even more frequently than during the sunny days of early autumn. At this time the characteristic tyrannical temper of the wren tribe showed itself. My wren had preëmpted the immediate vicinity of the stable, barn and other outbuildings, and woe betide any trespasser; snowbirds, sparrows, titmice and even bluejays were promptly warned off by the little tyrant. If they questioned his authority it was only to their sorrow. So it proved the long winter through. No other birds came near to stay. Spider-hunting, fighting and singing occupied all its moments, and, I am told, it

was often heard to whistle late in the night. Probably it was dreaming, which is not to be wondered at, considering the activity of the bird's brain when awake.

Thus for six months this bird lived quite alone. It certainly never wandered far at any one time. It was seen at too short intervals for this. But if lonely it was not morose, and to all appearance throve admirably from September to March.

From March to September it lived another life. As early as the 7th it appeared upon the scene with a companion. The two were very noisy and demonstrative. I could not detect much evidence of affection, and at times their actions were strongly suggestive of quarreling. This, however, did not last long. In the course of a week they had settled all their little differences, and hunted the spiders in the outbuildings, and early insects everywhere, in company. The song of the male bird was now more varied and frequent, yet never with a trace of mimicry of the notes of other birds. Its song in volume exceeded even the clear whistle of the cardinal grosbeak, and could be heard distinctly for half a mile during a still morning.

March 18 was a pleasant, spring-like day, and an early Maryland yellow-throat was singing merrily. This drew me out of doors, and I noticed directly that the Carolina wrens had commenced nest-building. Both birds were busy carrying long grass, strips of inner bark of shrubs and an odd thread or two that were found near by. One bird examined the clothes-line carefully, but could not succeed in unraveling any portion.

Following the wrens, I found they had located on the upper surface of one of the plates of the frame of the barn. The nest was directly under the roof, and quite filled the space between the upper surface of the plate and the shingles, about six inches. The nest, when completed, except the lining, was quite a foot in length. It was, in fact, a mere shapeless mass of loose material. Into this the female wren burrowed and remained most of the time, while the male bird brought softer fibers and chicken feathers. With these the cavity was lined and the nest completed.

March 24 an egg was laid, and anothereach day until the 29th, when the hen commenced setting. During the days that followed the male bird was very active in supplying his mate with food, and took his turn in caring for the eggs, but evidently under protest; this I conclude from the super-merry songs he uttered on

being relieved. Indeed it is a marvel to me that even a female wren can sit still. They have such nervous temperaments that an entire change of nidification, whereby solar heat could be depended upon, would, no doubt, be hailed by them with joy.

Five young birds were hatched April 9. When twenty days old they were able to fly, and had left the nest and apparently their parents. I saw them, evidently shifting for themselves, two days later, when they disappeared. May 14 the old birds were again building a nest, this time in another building, but in a similar position. The structure was identical in shape and size, but differed in being largely lined with snake-skins. It was completed by May 20, and a week later seven eggs had been laid, and June 7 six eggs were hatched. The young were on the wing July 1. July 15 a third nest was found nearly completed. Five eggs were laid by the 23d, and on August 8 the young birds of the third brood had appeared. These could fly by the 26th of the month, and had left the nest and the neighborhood by the 30th.

It is now a few days more than a year since my attention was particularly called to the single Carolina wren that frequented the stable. During the past twelve months it was closely watched, and every habit noted. When I was absent others observed it for me, and nothing of importance escaped attention. While I am writing these concluding lines I can hear the bird singing merrily as it sits upon the top of the hop-vine pole, of late its favorite perch. While listening to its song it is a proper time to sum up the results of what I have seen and heard. As a songster it ranks very high, and its utterances were all original. As a spider-hunter it is as active as any of the family of wrens. As a courageous foe of the English sparrows it is a blessing to the community.

THE BATRACHIA OF THE PERMIAN PERIOD OF NORTH AMERICA.

BY E. D. COPE.

THE class Batrachia holds an important position in the history of the Vertebrata, as the first member of that kingdom which occupied the land on the advent of the conditions suitable for air-breathing types. It thus stands in ancestral relation to the lines of the Sauropsida and Mammalia, and as the immediate descendant of the fishes.

There are several orders of Batrachia, and they display remarkable diversities of skeletal structure. For the better understanding of these, I give the following table of their principal definitions :[1]

I. Supraoccipital, intercalary and supratemporal bones present. Propodial bones distinct.

Vertebral centra, including atlas, segmented, one set of segments together supporting one arch ..... *Rhachitomi.*

Vertebræ segmented, the superior and inferior segments each complete, forming two centra to each arch. ..... *Embolomeri*

Vertebral centra, including atlas, not segmented; one to each arch.... *Stegocephali.*

II. Supraoccipital and supratemporal bones wanting. Frontal and propodial bones distinct.

a An os intercalare.

A palatine arch and separate caudal vertebræ..... *Proteida.*

aa No os intercalare.

A maxillary arch; palatine arch imperfect; nasals, premaxillaries and caudal vertebræ distinct ..... *Urodela.*

Maxillary and palatine arches distinct; nasals and premaxillaries united *Gymnophiona.*

No maxillary or palatine arches; nasals and premaxillary, also caudal vertebræ, distinct. ..... *Trachystomata.*

III. Supraoccipital, intercalare and supratemporal bones wanting. Frontals and parietals connate; propodial bones and caudal vertebræ confluent.

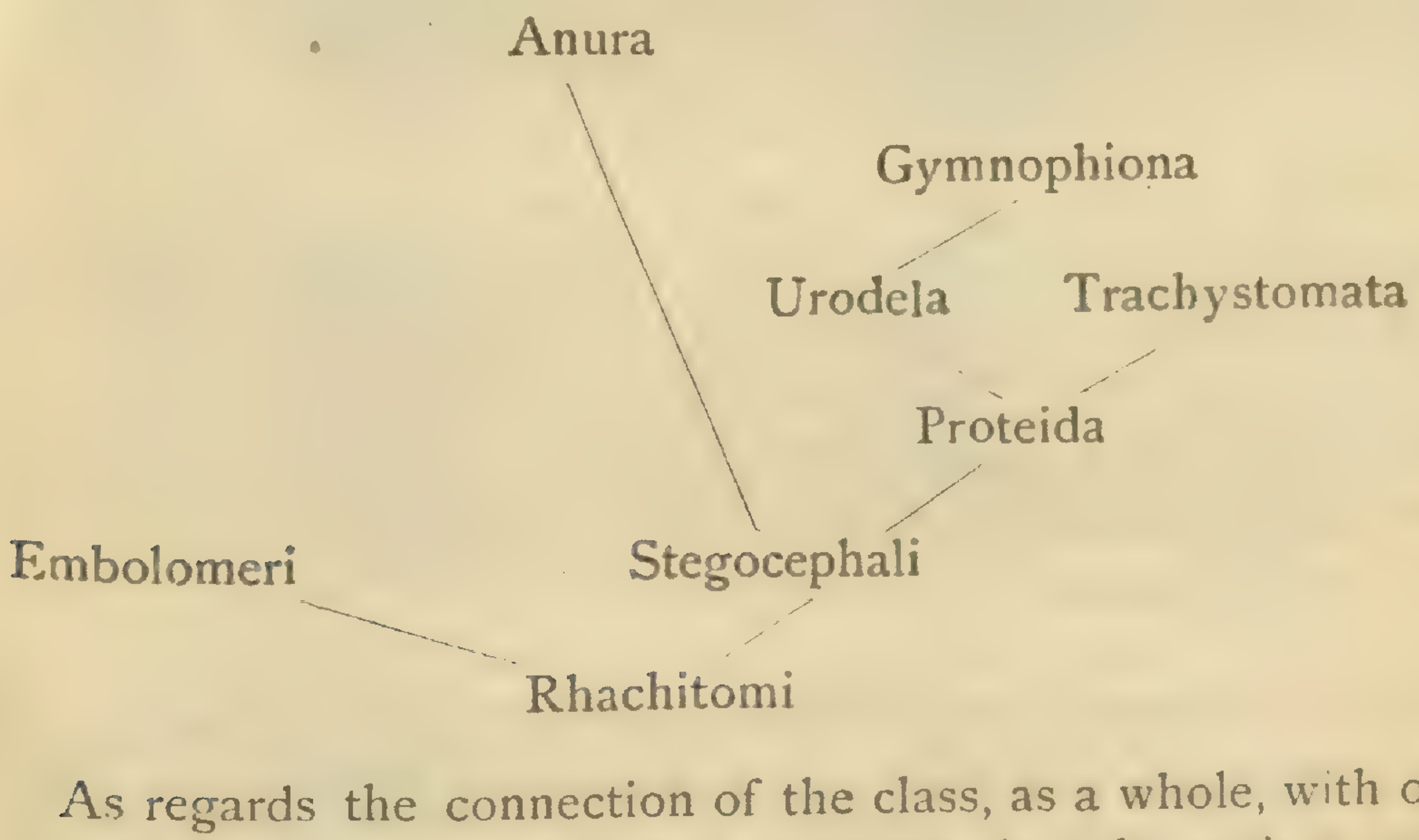
Premaxillaries distinct from nasals; no palatine arch; astragalus and calcaneum elongate, forming a distinct segment of the limb..... *Anura.*

The animals of the division I are all extinct. Division II includes the salamanders and their allies, with the worm-like Cœcilians (Gymnophiona); while the third division embraces the frogs, toads, etc.

[1] This is partly derived from the table which I have given in Vol. II Palæontology of the Geological Survey of Ohio, 1874, p. 352. See also Proceedings Philadelphia Academy, 1868, p. 211.

The characters displayed by the three divisions in question, indicate their relationships to be as follows: The orders of division I present in their cranial structure a greater resemblance to ... o-finned or crossopterygian fishes, than do either of the ... he third division is the most divergent from that type, ... arious respects the most specialized. This specializa- ... sists not only in a departure from the primitive Batrachia, but also from all other forms of Vertebrata. Its specialization is seen in the loss and coössification of various parts of the skeleton. The Urodela display characters intermediate between the extremes of the class. Near them the Trachystomata (Sirenidæ) are inferior by loss of parts of the skull, and of the pelvic arch, the result, probably, of a process of degeneration. The same is probably true of the Proteida, which have lost the maxillary arch of the Stegocephali, but retain their os intercalare.[1]

As regards the extinct orders, the primitive type is evidently the Rhachitomi, whose vertebral column displays an arrest of characters which are transitional in the higher Vertebrata. From this group the orders Embolomeri and Stegocephali have evidently been derived. We may then present the following genealogical table of the class Batrachia:



As regards the connection of the class, as a whole, with other classes of Vertebrata, it is very probable that the extinct orders, as the Rhachitomi, were derived from some extinct form of Dipnoan fishes more or less related to the group of which the genus Ceratodus is a representative. In this type we have a persistent chorda dorsalis; fins which present the type from which ambulatory

[1] Of Cuvier; Epiotic of Huxley, according to Vrolik.

limbs were derived; a pelvis; and a cranium nearer that of the batrachians than most other fishes present. The Crossopterygia are a little on one side of the parental stem, since they have no pelvis, and their limbs begin to show a beginning of that reduction and specialization, which is carried to such an extent in the Actinopteri, or typical fishes.

The Batrachia are supposed by Professor Huxley to have given origin to the Mammalia. There are many reasons to sustain this view, nevertheless no progress has yet been made by palæontological research in filling up the great interval which separates the Permian Batrachia from the Mesozoic Mammalia. It is also true that the limb bones of the Permian Reptilian order of the Theromorpha more nearly resemble those of the lowest Mammalia, the Monotremata, than do those of any other known forms.

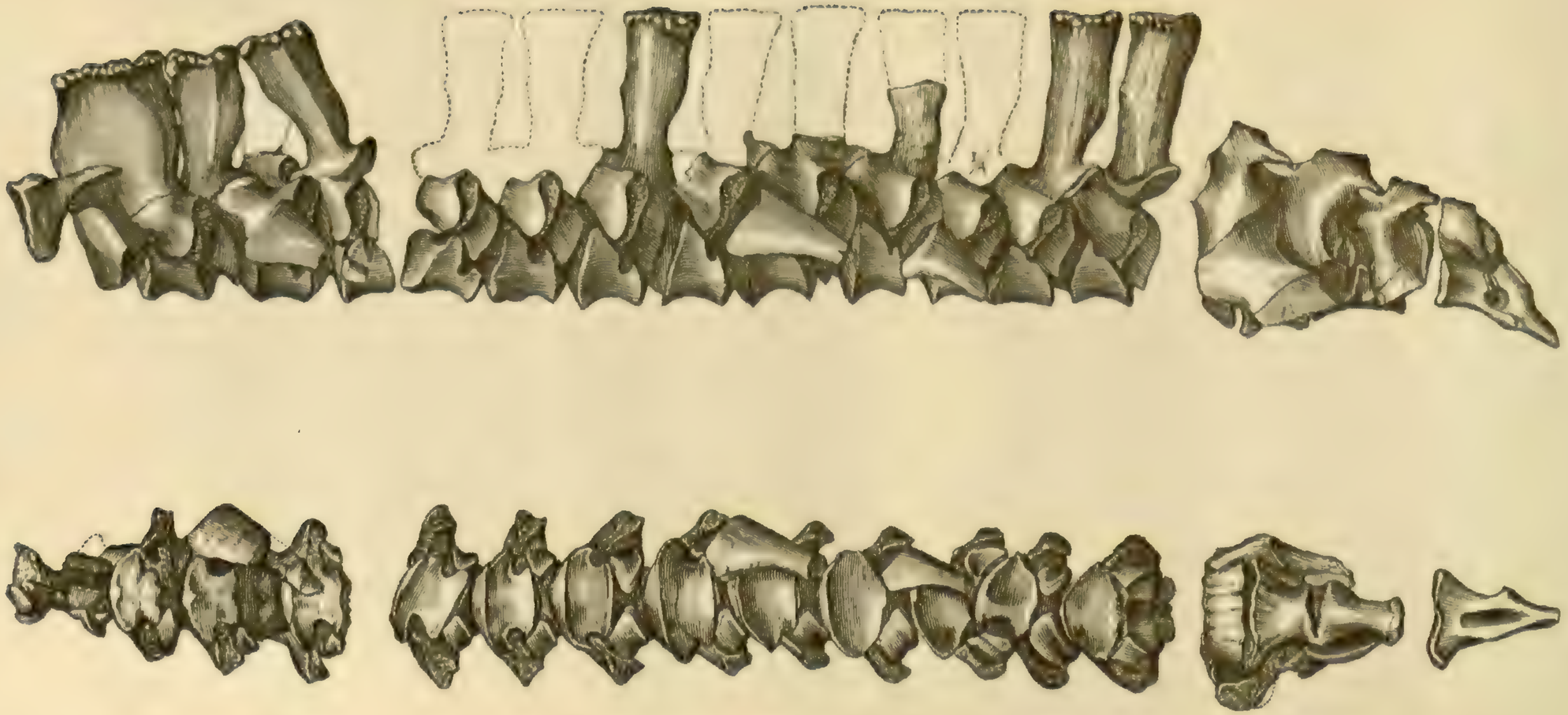
The Rachitomi.

I proposed this name[1] for a division of the Batrachia which predominated during the Permian period in both the old and new worlds. As stated above in the differential table, it is characterized by the primitive condition of its vertebral column. The cartilaginous chorda dorsalis was present in life, and the vertebral bodies are represented by ossifications of its sheath. In the Trimerorhachidæ this ossification is superficial or cortical, while in the Eryopidæ it penetrated more deeply into the chorda. The segments of the centrum are three in number, an inferior one or intercentrum, and a superior lateral one on each side, the pleurocentrum, as it is called by Gaudry. The lateral pieces support the neural arch, and on this account I have called them the centrum proper, as distinguished from the intercentrum. The neural arch is unbroken, and displays articular processes (zygapophyses) of usual form, and in some genera a large neural spine.

The shoulder-girdle of these animals is remarkable for the small size of the coracoid element, resembling in this respect the salamanders, and approaching the mammals. There is probably a clavicle, as has been observed by Gaudry in Actinodon. He also finds the three thoracic shields of the Stegocephali (episterna and entosternum). I have such bones associated with the American forms, but have not yet determined their species. The humerus has no head, but a band-like articular surface instead.

[1] American Naturalist, 1882, p. 333.

PLATE II.



ERYOPS MEGACEPHALUS Cope. ¼

Its condyles, when present, are, on the other hand, well developed, and resemble those of salamanders, and of certain Mesozoic and lowest Tertiary mammals, as Meniscoëssus of the Laramie, and Catopsalis of the Puerco. The terminal phalanges were not converted into claws, but were flat and obtuse, as in existing Batrachia.

The pelvic arch is intermediate between those of the Anura and salamanders, and resembled closely that of the Pelycosaurian division of the Theromorphous reptiles of the same age. The pubis and ischium are solidly united, without the intervention of an obturator foramen, and those of opposite sides form a boat-shaped body. This is suspended from the sacrum by a vertical ilium, which rises from near the middle of each side. Its proportions are about as in the salamanders. The femur has no head proper, and the distal condyles are better distinguished than in any other Batrachia and than in most Reptilia.

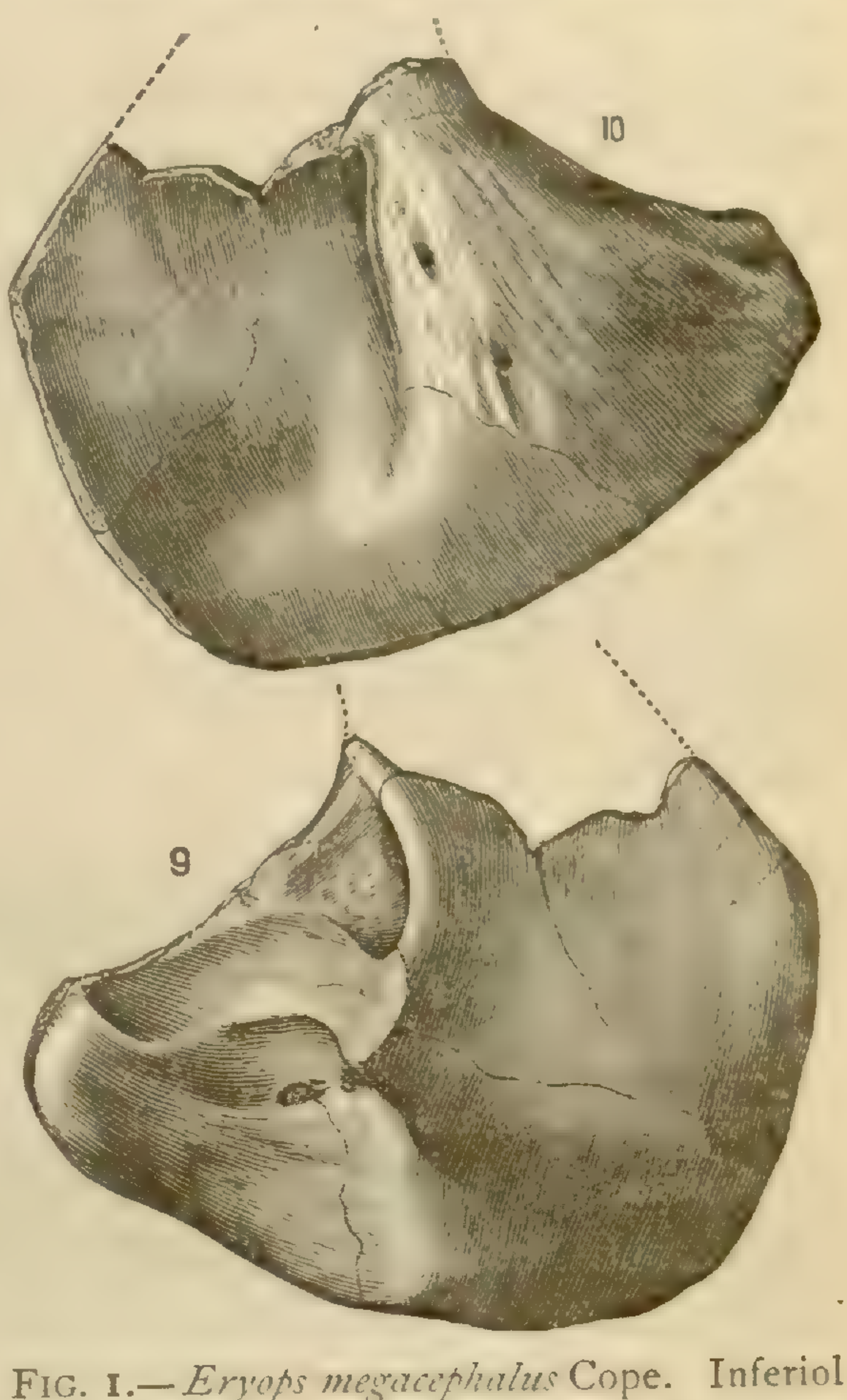


FIG. 1.—*Eryops megacephalus* Cope. Inferiol part of scapular arch of a different individuar from that represented in Pl. II; four-fifteenths nat. size. Upper figure from front; lower, posterior view.

The species of the Rachitomi are rather salamander-like in proportions, with relatively short legs and long tail, except in Eryops, where the latter was probably represented by a stump (see Plate II). They had relatively large heads with wide gape, as in the frogs. None of the known species can be supposed to have had powers of leaping as in those modern animals.

None of the known species had a formidable dentition, and in all of them the dentine is simply inflected, so that the section of a tooth presents a mass of closely-packed radii.

The two families of this order are well distinguished by the

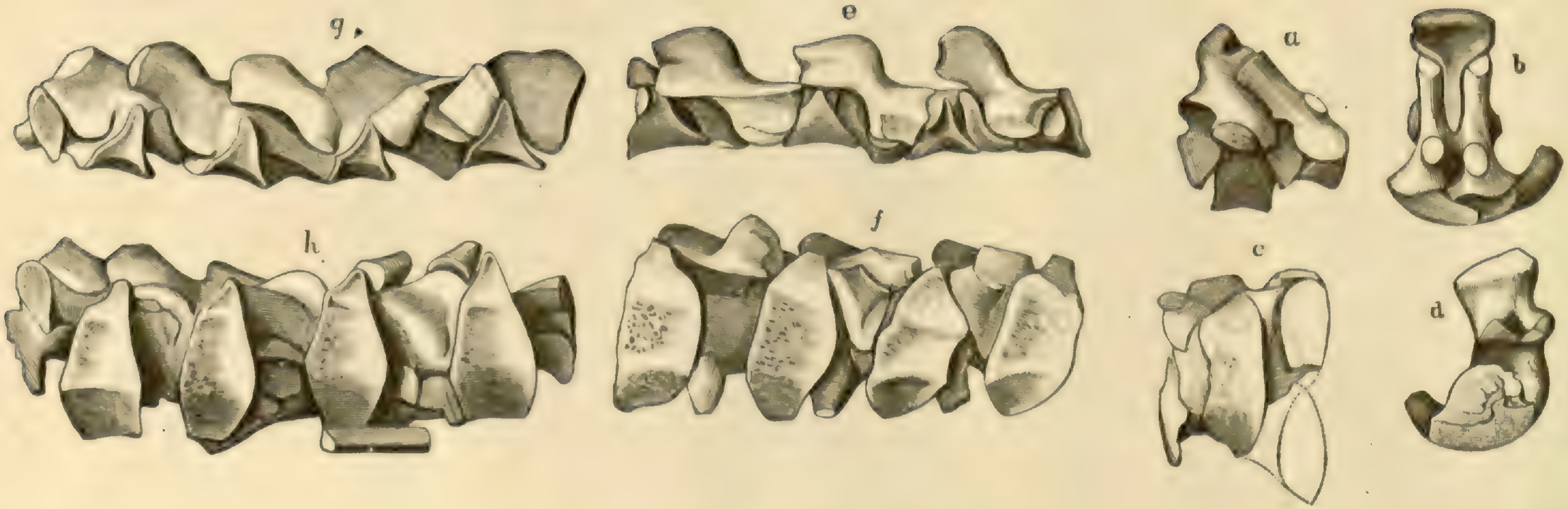
form of the basioccipital bone. In the Trimerorhachidæ its condyle is simple and concave, somewhat as in some fishes. The Eryopidæ have the two condyles characteristic of Batrachia generally. This difference might be esteemed as of greater than family significance, but it is less considerable than at first sight appears. The single cotylus-like basioccipital bone of the Trimerorhachidæ is notched above, sometimes deeply, to receive the apex of the notochord. A corresponding notch on the inferior edge would, if present, divide the articulation into two surfaces, which would greatly resemble the condyles of Eryops. The latter are flat and look partly towards each other, and are evidently separated originally by the *fissura notochordæ*.

To the Trimerorhachidæ I have referred, with certainty, only the genus Trimerorhachis. I have been unable to learn the structure of the vertebræ in the European genus Archegosaurus. According to some authors they are simple, as in the Stegocephali. Specimens of this kind, of the size of the *Archegosaurus decheni*, are found in the locality where the latter occurs, *i. e.*, Saarbrücken in Alsace; while rachitomous vertebræ from the same locality are of larger size, and resemble those of Eryops (**Mus. Princeton, N. J.**).

I have called attention to the structure of the vertebral column of the Rachitomi from a mechanical standpoint.[1] The notochord persists, the osseous elements about it in the sheath or skin, in the form of regular concave segments much like such segments as are cut from the skin of an orange, *i. e.*, parts of spheres, having greater or less thickness according to the group or species. Now the point of divergence of these segments is on the side of the column, the upper segments rising, and the lower segments expanding downwards. To the upper segments are attached the arches and their articulation, and the lower segments are like the segments of a sphere. If you take a flexible cylinder, covered with a more or less resistant skin or sheath, and bend that cylinder sidewise, you will of course find that the folds of the surface will take place along the line of the shortest curve, which is on the side; and, as a matter of fact, you will have breaks of very much the character of the sutures of these vertebral segments. It may not be so symmetrical as in the actual animal, for organic growth is symmetrical so far as not interfered with; for, when we have two

[1] *Science*, 1883, p. 276.

PLATE IV.



TRIMERORHACHIS INSIGNIS Cope. $\frac{1}{1}$

forces, the one of growth and the other of change or interruption, and they contend, we still have in the organic being a quite symmetrical result. In the cylinder bending in this way, of course the shortest line of curve is at the center of the side of the cylinder, and the longest curve is at the summit and base, and the shortest curve will be the point of fracture. And I presume it has happened in the case of the construction of the segments of the sheath of the vertebral column that the lateral motion of the animal swimming has been the actual cause of the disposition of the osseous material in this form.

A very good illustration of the effect of bending of a more or less flexible cylinder may be seen in the folds on the inner concave side of one's coat sleeve. In the accompanying figure the folds in the cloth represent the lines of flexure, or what would be

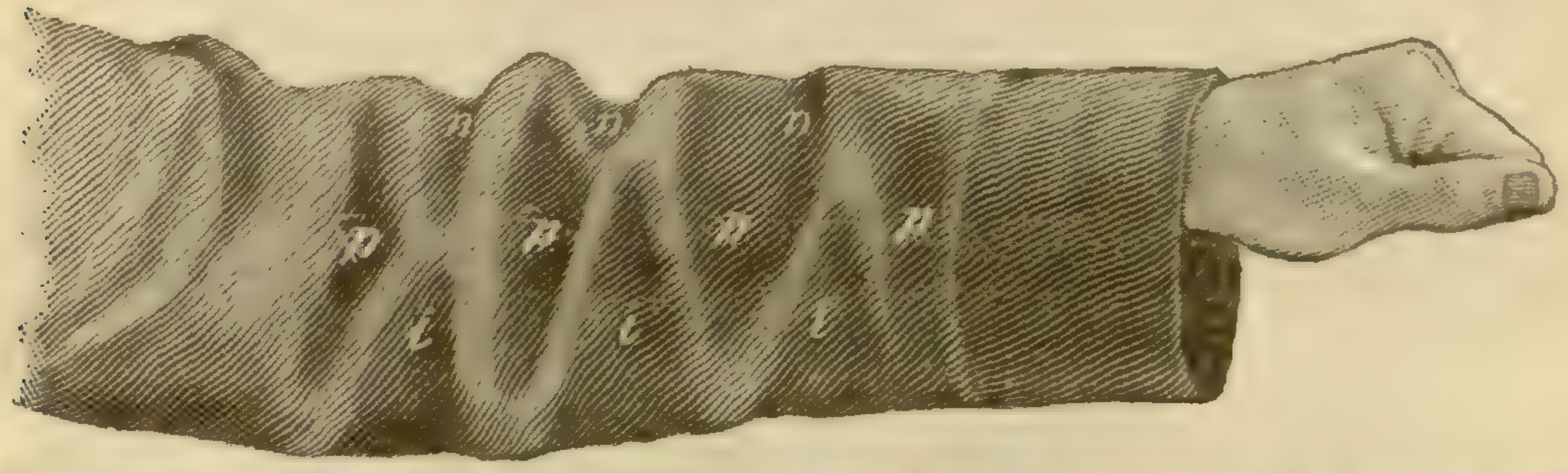


FIG. 2.—Sleeve of a coat, showing folds produced by lateral flexure, which leave interspaces similar to the segments of a rachitomous vertebra. Thus *i* represents intercentrum, *p*, pleurocentrum, and *n*, neurapophysis.

in a seat of ossific deposit, of interruption; while the interspaces represent the segments bounded by such lines. The correspondence with the segments of the vertebræ of the Rhachitomi is remarkable. At the base we have the wide lenticular intercentrum (viewed partly from below in the cut); between their lateral apices we have the pleurocentra, and above, another segment, which in the vertebra is the base of the neural arch.

The view that the segmentation of the vertebral column is the result of lateral alternating strains, was proposed by Herbert Spencer (Principles of Biology, II, p. 195). The present researches confirm this hypothesis in general. Mr. Spencer did not, however, specify the kind of segmentation to be expected from this process, and leaves it to be inferred that the segments will be cylinders of greater or less length. Thus he says (p. 205) "in a vertebral column of which the axis is beginning to ossify, the centrums consist of bony rings inclosing a still continuous rod of cartilage." And it is true that this is the primitive form in

embryology, but whether true in any instance in palæontological history yet remains to be ascertained.

TRIMERORHACHIS Cope.

This genus presents the most imperfect vertebræ known in the order. It differs from all others, including Archegosaurus, in the lack of a distinct neural spine. Its humeri do not display condyles, but had cartilaginous articular surfaces. The teeth are rather small

FIG. 3.—*Trimerorhachis insignis*, skull from above; one-half natural size. Smaller figure; muzzle showing sculpture and nares.

and of equal size, except a large one or two inside the external series near the anterior part of the mouth.

Two species are known, the *T. insignis* Cope, and *T. bilobatus* Cope, both from the Permian beds of Texas. Both were probably of slender proportions, and had short weak limbs.[1] The head of the *T. insignis* is wide, flat and rounded, and its superior surface is strongly wrinkled. The lyriform mucous groove does

[1] This proportion is not certainly known.

not extend behind the orbits. This was a very abundant species

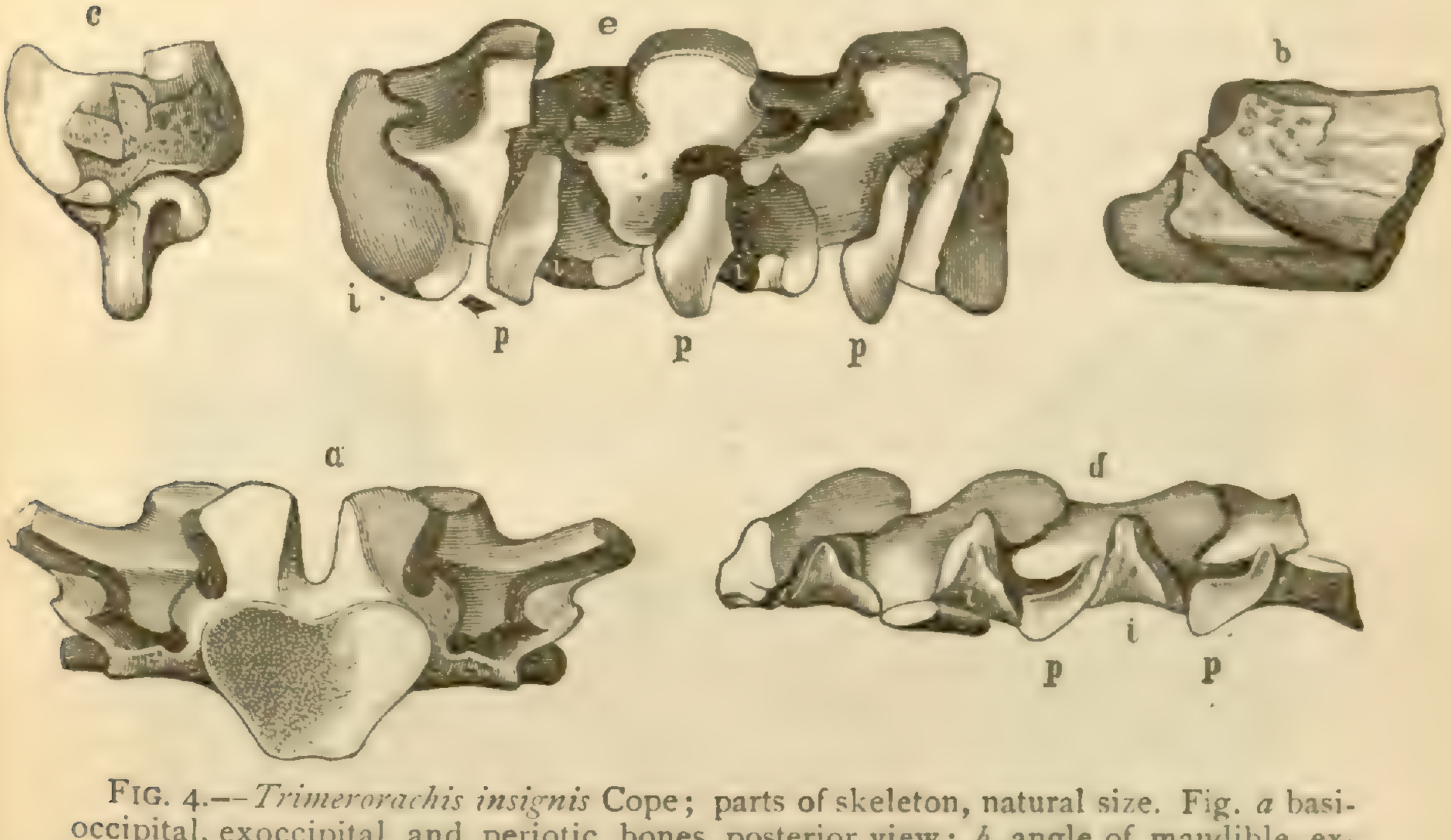


FIG. 4.—*Trimerorachis insignis* Cope; parts of skeleton, natural size. Fig. *a* basi-occipital, exoccipital and periotic bones, posterior view; *b*, angle of mandible, external view; *c*, the same, posterior view; *d*, part of vertebral column depressed by pressure, showing the intercentra (*i*) and the pleurocentra (*p*); *e*, a part of the vertebral column, oblique view, showing double neural arches and zygapophyses.

during the Permian period in Texas, and probably possessed aquatic habits.

ERYOPS Cope.

This genus is the best-known American representative of the Eryopidæ. This family includes also Acheloma, Anisodexis, and probably Zatrachys in America, and Actinodon in Europe. The last-named genus occurs in the Permian beds near Autun, in Central France, and has been well elucidated by the labors of Professor Gaudry of the Jardin des Plantes.

In Eryops the teeth are arranged much as in Trimerorhachis, in external series of nearly uniform size, with some large ones in the anterior parts of both jaws, a little within the external rows. As in that genus, the supra-temporal does not display a free external margin, as it does in Cricotus, and there is no angular process of the mandible. There is, on the other hand, no lyra. The intercentra and pleurocentra are much more robust than in Trimerorhachis. The neural spines of the vertebræ are large, and [illegible]anded summits. The caudal vertebræ appear to have [illegible] few, and to have been confluent into a short conical [illegible]ne inferior elements of the pelvis are remarkably

heavy, the pubis being thickened in front, and truncated with a flat V-shaped face with reverted lip.

Three species of this genus are known. The most abundant in the Permian of Texas is the *E. megacephalus* Cope (Figs. 1 and 5–6). This is the largest American batrachian, the skull measuring a foot wide by eighteen inches long. It was very abun-

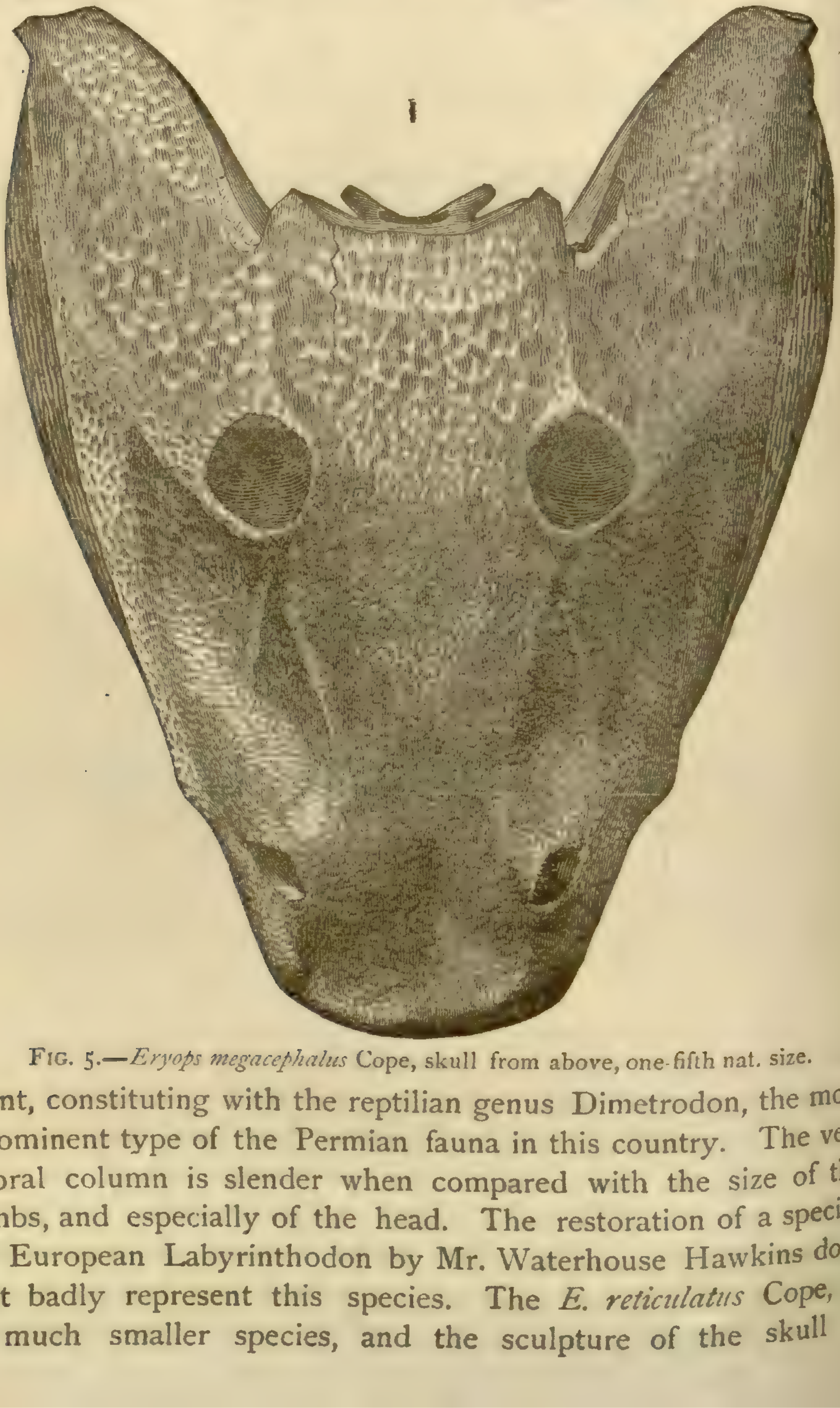
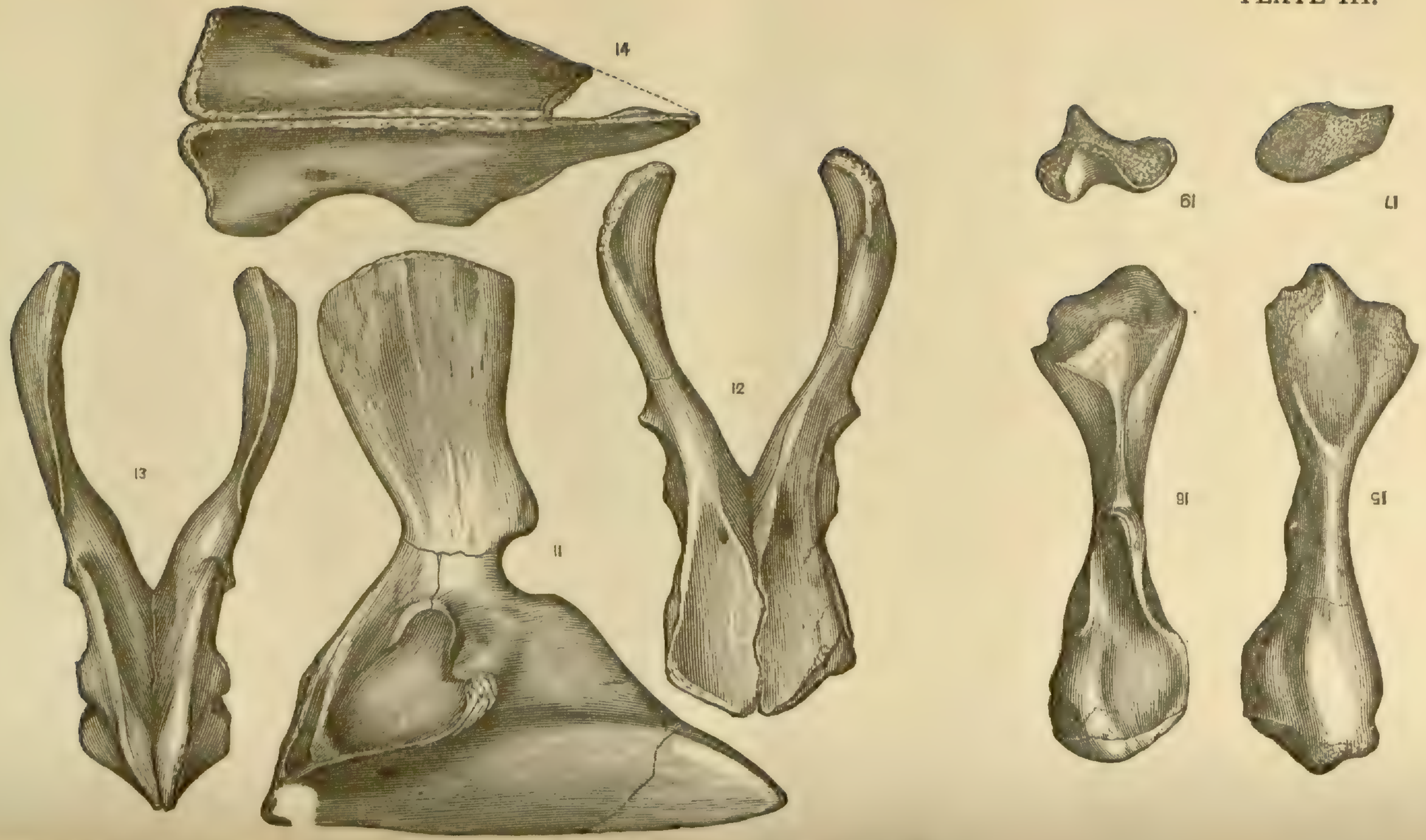


FIG. 5.—*Eryops megacephalus* Cope, skull from above, one-fifth nat. size.

dant, constituting with the reptilian genus Dimetrodon, the most prominent type of the Permian fauna in this country. The vertebral column is slender when compared with the size of the limbs, and especially of the head. The restoration of a species of European Labyrinthodon by Mr. Waterhouse Hawkins does not badly represent this species. The *E. reticulatus* Cope, is a much smaller species, and the sculpture of the skull is

PLATE III.



ERYOPS MEGACEPHALUS Cope. $\frac{1}{4}$

sharper and of a net-like pattern. The neural spines are not so much expanded at the apex. It has been found in the Permian beds of New Mexico. The *E. ferricolus* Cope, is a still smaller species, known from skulls from Texas. This, with the *E. megacephalus* and the *Trimerorhachis insignis*, were found by Mr. Jacob Boll, a naturalist of Dallas, Texas, who was a man of many accomplishments and an ardent explorer. He lost his life through

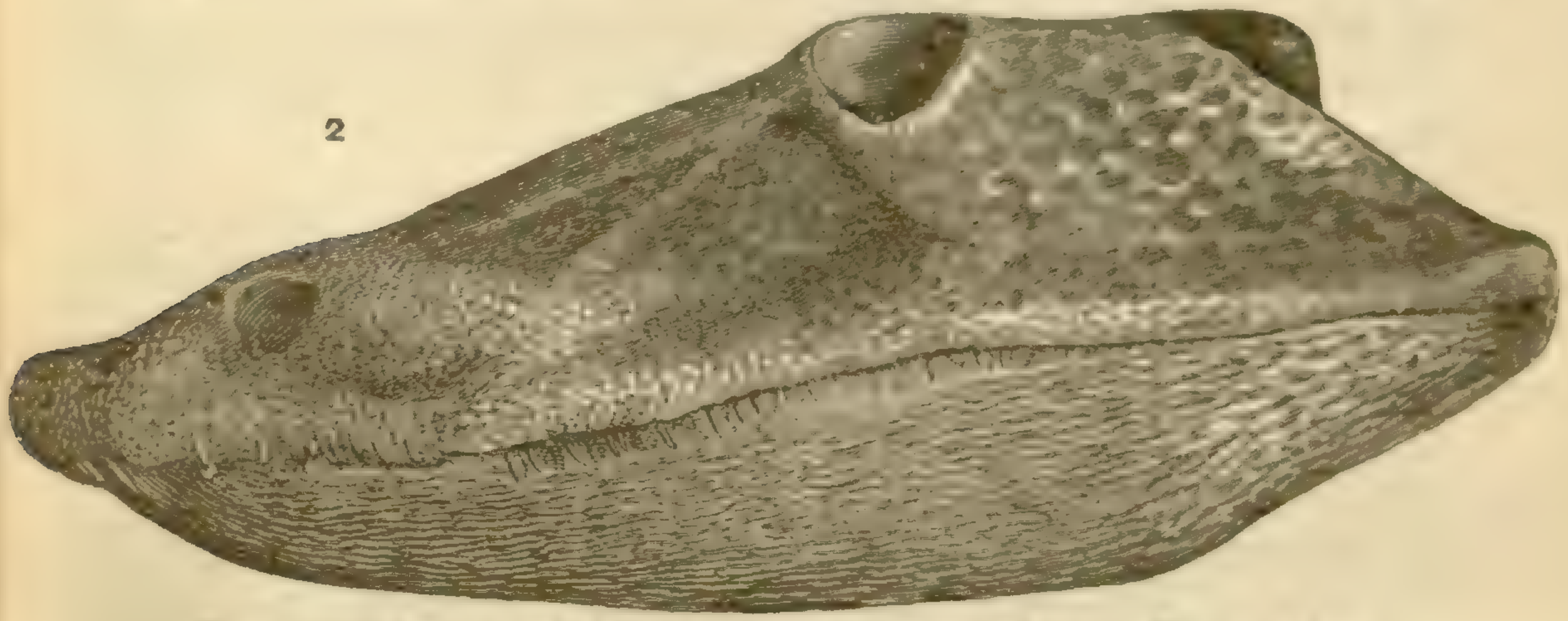


FIG. 6.—Side view of skull of *Eryops megacephalus*, one-fifth nat. size.

his indifference to his personal comfort while exploring the Permian beds at my instance.

ACHELOMA Cope.

This genus is allied to Eryops, and differs in two principal points. One of these is the absence of the lateral border of the cranial table formed by the external side of the *os intercalare* in Eryops and various other genera, the posterior outline of the skull being thus continuous. The other is the absence of the condyles of the humerus, a point in which it resembles Trimerorhachis. The vertebral segments are more robust than in Trimerorhachis, and less so than in Eryops; and it agrees with those genera in the absence of the mandibular angular process.

The only known species of this genus is the *A. cumminsi* from Texas. Its structure is pretty well known. It resembles in general the *Eryops megacephalus* with its small orbits and absence of lyrate groove, but is smaller and differs in various details. The skull is triangular, and measures a little more than seven inches long by five wide, and has an open honeycombed sculpture of the surface. The vertebræ and limbs are small for the size of the skull; and in the former the summits of the neural spine are not expanded.

ANISODEXIS Cope.

This genus differs from those previously described, in the inequality in the sizes of the teeth of the external series. Thus in the upper jaw there is a very large one in the position of a canine, and in the lower jaw there are some large ones near the symphysis. The neural arch of the vertebræ resembles that of the genus Acheloma. The *A. imbricarius* Cope, is the only known species, and is represented in collections by fragments only. The size of its skull is nearly that of the *Eryops megacephalus*. The sculpture of the superior surface of the skull is a coarse reticulation; that of the sides of the jaws is of an imbricate or shingle-like character. The limbs are unknown. The vertebræ do not exhibit an expansion of the summit of the neural spine. From the Texas beds.

ZATRACHYS Cope.

This genus was originally represented by a maxillary bone, which supports teeth of equal length, and whose surface is extraordinarily rugose. In the typical species, *Z. serratus*, the rugosities project in the form of teeth along the external alveolar border. Individuals with sculptured neural spines and dermal bones are referred here. The intercentra are much like those of Eryops and Acheloma.

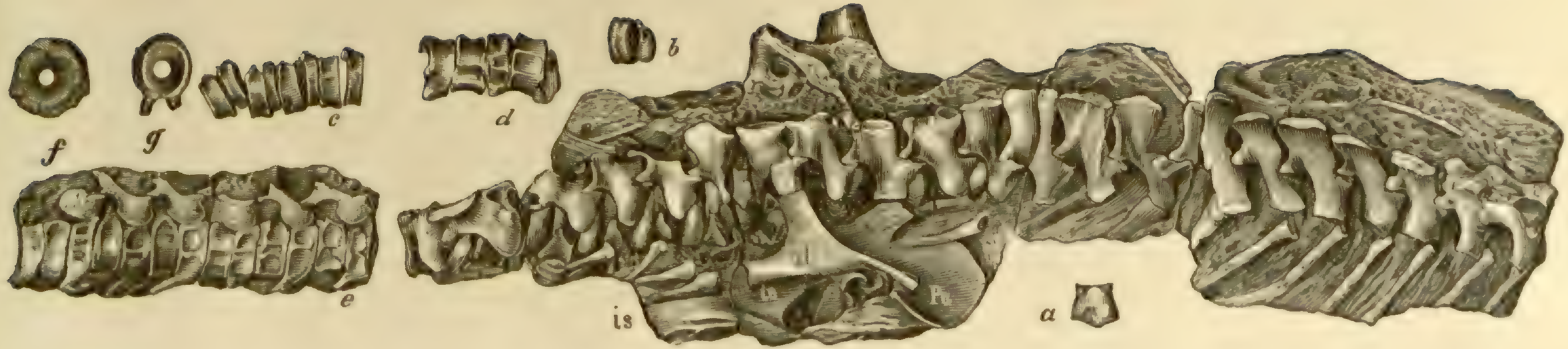
Two species are known, *Z. serratus* Cope, from Texas and *Z. apicalis* from New Mexico. In the latter the neural spines have much expanded apices, with sculptured superior surfaces. The animal may have been four or five feet in length, while the *Z. serratus* could not have exceeded three feet. Both species were well protected from the assaults of the cotemporary carnivorous saurians by their dermoössifications.

EMBOLOMERI.

I proposed this order in 1880[1] to receive the family of the Cricotidæ. This remarkable form has been characterized in this journal[2] and elsewhere, by the complete development of its centra and intercentra, both of which form entire vertebral bodies which in pairs support single neural arches. No such character has been detected in the known divisions of the Stegocephali. Its

[1] AMERICAN NATURALIST, p. 610.

[2] Loc. cit. 1876, p. 405; 1878. p. 319. Proceedings Am. Philos, Soc., 1878, 523



CRICOTUS HETEROCLITUS Cope. $\frac{2}{3}$.

characters were given as follows. I have not been able to expose the occipital condyle in my specimens.

Centra and intercentra subequally developed as vertebral bodies, a single neural arch supported by one of each, forming a double body. Chevron bones supported only by intercentra. Basiocci-pital vertebral articulation connected with the first vertebra by an undivided discoid intercentrum.

Thus the peculiarity of the vertebral column in general is carried into the cephalic articulation, and we have, instead of the complex atlas of the Rachitomi, a single body connecting the occipital condyle and first vertebra. This body represents, in all probability, *the single occipital condyle of the reptilian skull.* This part, as is well known, remains cartilaginous in the lizard long after the basioccipital is ossified,[1] and is a distinct element. In the Urodele Batrachia it appears, according to Albrecht, as the odontoid process of the *atlas.* The structure of Cricotus shows that it is a connate intercentrum. We have thus removed the last difficulty in the way of the proposition that the Reptilia are derivative of the Batrachia, viz., the difference in the cranio-vertebral articulation. But the former have not been derived from the Labyrinthodontia, as has been suggested, nor from the Rachitomi, but from the Embolomeri. The order of Rep-tilia which stands next to it is, of course, the Pelycosauria of the same period, which presents so many Batrachian characters, including intercentra, as I have for the first time pointed out in the paper above quoted.[2]

Professor Gaudry has been inclined to regard the bones which I have called intercentra as the true centra. But in the Embo-lomeri we have evidence that the pleurocentra are the true centra, since they assume the larger bulk, and support the neural arch and costal articulation, the intercentrum becoming more and more subordinate as we advance from the caudal series forwards. Moreover, the intercentrum bears the chevron bones in the Rhachitomi, and the Embolomeri, as they do in the cotemporary Pelycosauria.

I add to the ordinal characters above given, that the three pec-oral shields of the Stegocephali are present here also.

[1] See Parker On the development of the skull of the Lizard, Philosophical Trans-actions, London, 1879.

[2] Intercentra remain in the cervical and dorsal series of Hatteria, and there is one at least in the cervicals of the Pythonomorpha.

Besides Cricotus, Fritsch describes a genus from Bohemia under the name Diplovertebron, which I suspect to belong to the Embolomeri.

In the family Cricotidæ the chorda dorsalis is persistent and large. The vertebral centra and intercentra are perforated so as to resemble some kinds of discoidal beads. They form a characteristic feature among the Permian fossils. The abdomen is protected by scales arranged in chevrons. There is a parietal foramen, and the supratemporal bone has a free external border like the squamosal of the crocodile.

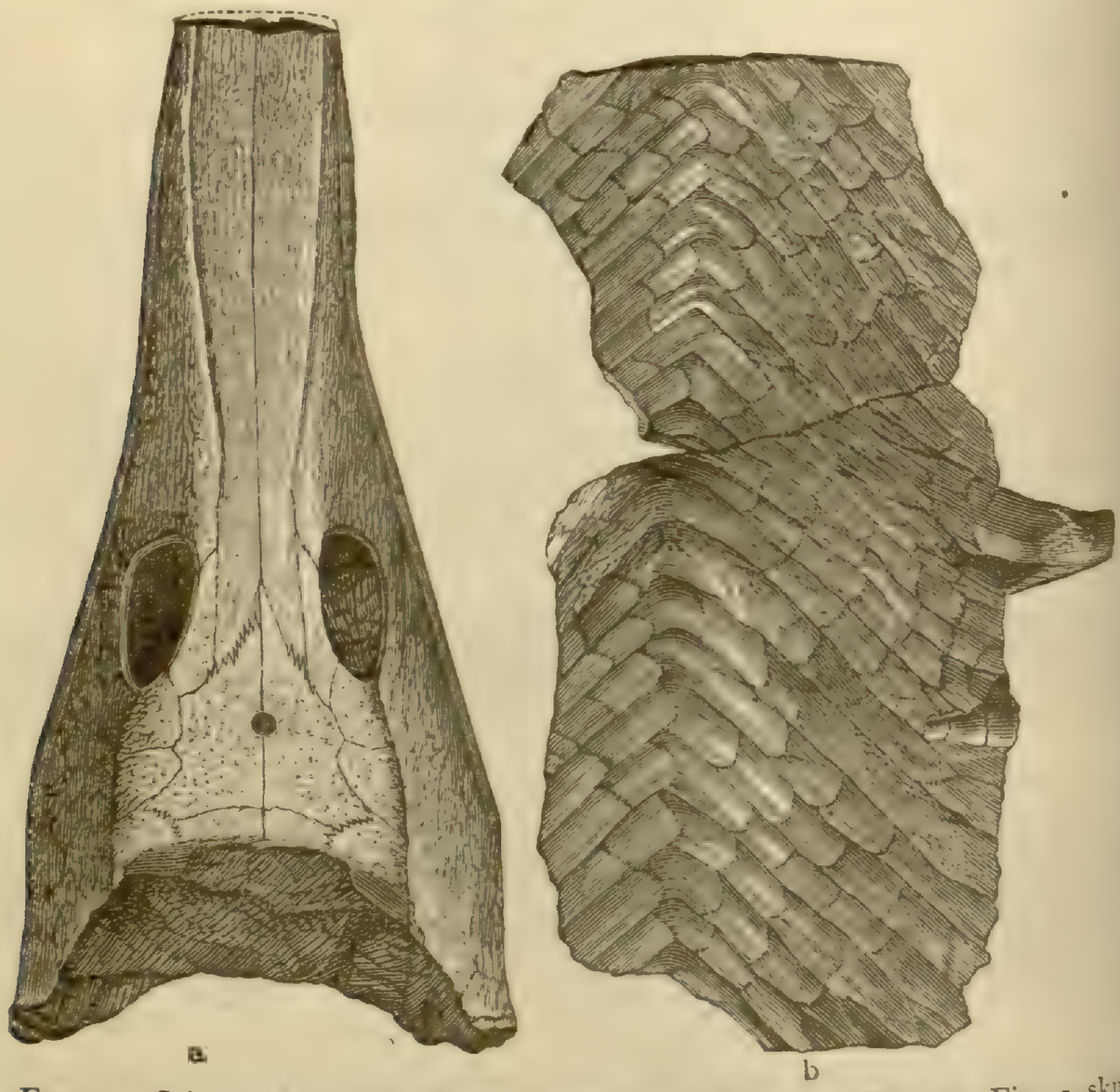


FIG. 7.—*Cricotus heterochitus* Cope, the specimen figured on Plate v. Fig. *a*, skull from above, one-half nat. size, end of muzzle wanting; *b*, abdominal surface, showing scuta, distal extremity of femur and distal three phalanges of a digit, one-half nat. size.

CRICOTUS Cope.

In this genus the teeth are rather large, and are of subequal size in the external rows. The tail is long, and was apparently useful as a natatory organ. The terminal phalanges are obtuse as in salamanders, and without claws. The pelvis has the character of that of the Eryopidæ, but is less massive anteriorly. The

lower jaw has no posterior projecting angle. There are mucous grooves on the skull. The abdominal scales are oblong and in close contact with each other.

Cricotus heteroclitus was first found in Illinois, and afterwards in Texas. It is a more elongate animal than any of those described in the preceding pages, and it was furnished with short, rather stout limbs. It probably reached a length of ten feet, as my best preserved specimen, which is not the largest, measures about eight feet. It has an elongate triangular skull, eleven inches by six behind, with a singularly long, narrow, depressed muzzle, whose extremity overhangs the lower jaw completely. There are three pairs of mucous grooves; one is on each side of the roof of the muzzle, and runs out on the edge of the upper jaw, where it overhangs the extremity of the corresponding ramus. The second descends from behind the orbit, and running parallel to the edge of the upper jaw, joins the first at the usual position of a canine tooth in other forms. The third extends along the internal inferior edge of the mandibular ramus.

This species was probably aquatic in its habits. A smaller species, the *C. gibsoni*, has been described from Illinois. Its caudal vertebræ are of more elongate, cubical form than those of the *C. heteroclitus*.

EXPLANATION OF PLATES.

PLATE II.

Eryops megacephalus Cope, vertebral column, one-fourth natural size, the upper figure from the left side, the lower figure from below. The four sections of the column represented are parts of the same individual.

PLATE III.

Eryops megacephalus Cope, pelvic arch and femur, four-fifteenths natural size, belonging to the individual figured in Plate II. Figs. 11–14 pelvis; 11, left side; 12, front; 13, posterior view; 14, from below. Figs. 15–19, femur; 15, anterior view; 16, posterior view; 17, proximal view; 19, distal view.

PLATE IV.

Trimerorhachis insignis Cope, part of vertebral column flattened by pressure, of probably one individual, natural size. The upper figures (except *b*) from the right side; the lower (except *d*) from below. Figs. *a–d*, atlas and axis, the former with double intercentrum; the latter with single intercentrum. Fig. *b*, anterior view; Fig. *d*, posterior view.

PLATE V.

Cricotus heteroclitus Cope, part of skeleton of one individual, excepting Figs *f* and *g*, two fifths natural size. The vertebræ on the larger block include the posterior extremity of the dorso-lumbar series of the specimen as preserved, viewed partly from above. Fig. *a*, first cervical intercentrum, anterior face; *b*, the same attached to front of first cervical centrum, lateral view; *c*, four cervical centra separated by intercentra, partly from below; *d*, *e*, caudal vertebræ from below; caudal vertebræ from right side. Figs. *f* and *g*, specimens of the same from Illinois, anterior views; *f*, a dorso-lumbar intercentrum; *g*, a caudal intercentrum with bases of chevron bone; all two-fifths natural size.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The first and hasty conclusion of many people on the perusal of Darwin's Origin of Species was, that the populations of the earth, including ourselves, are the food for the mills of unconscious and implacable forces, or at best are the sport of aimless chance. And so long as all evolution was supposed to be included in the two words "heredity and natural selection," there was good ground for pessimism, and even despair. It is a fact that in the early stage of thought on this subject, teachers as well as scholars underrated the importance of the question of the origin of variation, or the "origin of the fittest," although it had been publicly discussed in France a third of a century earlier.

The laws of mechanical evolution which are adduced to explain the "origin of the fittest;" do they give any relief to anxious humanity from undiscriminating domination of "the God of Forces?" The very term, "mechanical evolution," would seem to preclude any opportunity for the element of personality either as author or director. The pessimist and the fatalist may still apparently claim the field. But the nature, and hence the origin, of "the fittest," must be thoroughly understood before such judgment can be pronounced on the order of things.

With the advent of sensibility came pleasure and pain. Pessimism is the belief in the *reign of suffering*. On the other hand hedonism believes, if not in the reign of pleasure, at least in the reign of the greatest happiness to the greatest number. Do sensitive beings walk open-eyed into pain or pleasure once known, without fear of one or anticipation of the other? Every one knows to the contrary. Memory has been the teacher of the ages, so that the avoidance of pain and the pursuit of pleasure has been the business of living things since the dawn of consciousness and the existence of memory. It is more than probable that these prime movers of the universe have directed the mechanical forces into profitable channels, and have converted them to their use. More than this, mechanical evolution means the development of the machine that directs other machines, the brain, and the mind. Hence mechanical evolution is the evolution of intelligence. Of course the lessons of experience are in part lessons of pain, and beings that cannot act in accordance

with lessons sufficiently learned, will experience a maximum of suffering, and may have foundation for a private stock of pessimism of their own. But a tolerance of suffering is of various duration, and sooner or later intelligence will have its beneficent way. And as "knowledge is power," it results that the evolution of the living world and of men, has been and will be very much as they have it, and enlightened intelligence, well lived up to, has always resulted in a minimum of pain.—*C.*

—— The numbers of the AMERICAN NATURALIST for 1883 were issued at the following dates: January, Jan. 5; February, Jan. 31st; March, Feb. 21st; April, March 15th; May, April 18th; June, May 17th; July, June 20th; August, July 16th; September, Aug. 15th; November, Oct. 19th; December, Nov. 28th.

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RECENT LITERATURE.

HATTON AND HARVEY'S NEWFOUNDLAND.[1]—This is a successful account from historical, physiographic, ethnographic and economic points of view of the first English colony, and the last to be developed. It is the joint production of a resident on the island, Rev. Mr. Harvey, who with general culture and an intimate knowledge of the land and its inhabitants, unites a hearty appreciation of science, and is well known for the interest he has taken in the natural history of the Newfoundland seas; and of Mr. Hatton, who has rewritten and edited the whole work. For our part we do not see but that Mr. Harvey was quite competent for this task both as a writer, observer and collector of the facts. However that may be, the result is an authoritative, accurate, pleasantly written and timely manual of Newfoundland, with excellent full-page illustrations and others in the text. The map should have been a much better one; otherwise we have little fault to find with the volume.

The history of Newfoundland has been a peculiar one. The authors say it presents the British government at its worst and its best. How the "worst" could have been much worse, and how bad the "best" has been, is clearly brought out, and is an interesting study in sociology. The dominance of selfish greed on the part of a few British merchants, and the absence and entire lack for years of even rational and humanitarian feelings on the part of the mother-country, shows how many savage traits survived in the Anglo-Saxon race, of the best specimens, a century

[1] *Newfoundland. Its History, its Present Condition, and its Prospects in the Future.* By JOSEPH HATTON and the Rev. M. HARVEY. Reprinted from the English edition; revised, corrected and enlarged. Illustrated. Boston, Doyle & Whittle, 1883. 8vo. pp. 431.

ago. Perhaps less consideration was shown to the incipient colony than the codfish—the white of the Newfoundland egg—bestows upon its own spawn. For not content with leaving the infant colony to nature, the mother-country proceeded to dwarf and mutilate it, and so retard its development that it is least in the list of dependencies of the British Empire.

How this was done, and how fair are the future prospects of the colony, the reader may find in the first part of the book itself. The second part treats of the physical geography and topography. There is much more arable land, valuable forests and a much milder climate in Southwestern and Western Newfoundland than is ordinarily supposed. Even the vicinity of St. Johns has a much milder winter climate than that of Montreal, the thermometer scarcely falling below zero; on the other hand the northeastern coast has a subarctic climate akin to that of Labrador.

The account of the geology of the island is mostly taken from the report of Mr. Murray, the director of the Geological Survey of Newfoundland, a work still going on. From the chapter on the aborigines it appears that they were the Bethuk tribe, a branch of the Algonkin race, and quite distinct from the Micmacs, now inhabiting Nova Scotia. So effectually were these hapless people exterminated by the settlers, that only a single skull remains on the island, which is now preserved in the local museum of St. Johns. The skill of some of the Bethuks in drawing is thus described on p. 176, where reference is made to a woman of the tribe taken prisoner in 1823: "She is described as six feet high, and having a fine figure; her complexion swarthy, like the Micmacs, and her features handsome. In her manners she was bland, affable and affectionate. When a pencil and a piece of paper were given to her, she drew a deer perfectly at a few strokes, and what was most surprising, she began at the tip of the tail." This woman and her two daughters were the last of the red Indians seen alive. She died at St. Johns of consumption, after six years of civilized life. The account of this tribe, their habits and language, has been prepared with evident care. It is interesting that no mention is made in the book of the Esquimaux. There are probably no traces of them in Newfoundland. This is rather curious, as Esquimaux have extended along the Labrador coast to the Straits of Belle Isle, the survivor having been seen by the writer of this notice at Caribou island, near the south-western entrance of the straits, in 1860. If there are yet to be found any trace of the Esquimaux in Newfoundland, we hope so competent a man as Mr. Harvey will look them up and report upon them.

Naturalists and sportsmen will find much to interest them in the chapters on the animals and plants, and that on Newfoundland as a sporting country.

As would be expected, Mr. Harvey has given a full account

On the Barrens. The Carribou, Buck and Doe.

of the giant squids which have shown such a partiality for the shores of this kraken-haunted land. His references to the great auk are interesting. We quote them all for the convenience of our ornithological readers. Whitbourne's account, entitled "A Discourse and Discovery of Newfoundland," was published on his return from the island, where he spent the summer of 1816. In this work he speaks of the "penguin," as big as a goose, which in vast flocks covered many of the small islands, and were met with in large numbers as far out as the Banks. "The last reference," says our authors, "is to the 'great auk,' now numbered among the extinct birds, but in Whitbourne's day it abounded in the Newfoundland waters. For the last eighty years not a single specimen of the great auk has been seen, and there are but a few skeletons of this singular bird in all the museums of the world" (p. 24).

Again after speaking, on p. 135, of Fortune bay, our authors state: "From Fortune bay there is a straight line of coast called the 'western shore,' which is upwards of one hundred miles in length, and terminates at Cape Ray. It is indented with numbers of small bays and harbors, the largest being La Poile and Rose Blanch bays. There are also numerous clusters of islands, such as the Penguin islands, so called from the multitude of birds of that name which were formerly seen there.

"The great auk was once found in myriads around the shores, but is now extinct everywhere, not a specimen having been found for the last fifty years. The little auk, the puffin, the common guillemot, called locally the 'murr and turr,' and the razor-billed auk are abundant. The great auk was a very remarkable bird, and deserves more than a passing mention. It must now be reckoned, like the dodo, among the things that have been, though in the sixteenth and seventeenth centuries it was to be seen in multitudes on the low rocky islands on the eastern coast of the island, and immense flocks of them were encountered by the mariners of those days as far out as the Banks. Now the discovery of a single living specimen, or even of a skeleton, would be hailed as a most fortunate event. The last auk was shot on an isolated rock of the south coast of Iceland. in 1844, and is now in the museum of Copenhagen. In all the museums of Europe and America there are only seventy-two specimens of the bird. Three of these were found on Funk island, off the north-eastern coast of Newfoundland in 1864. They came into the possession of Bishop Field, who forwarded one to Agassiz, another to Professor Newton, of Cambridge, and the third ultimately reached the British Museum, where there is but one other specimen, brought from the Orkneys in 1812. Numerous bones of the great auk have been found on Funk island, and a careful search might discover many perfect skeletons. The great auk was larger than a goose. Its wings were very small, and not constituted for flight,

but were admirable paddles in the water, enabling the bird to move about even more swiftly than the loon. The legs were extremely short but powerful, and placed so much posteriorly that in resting on the rocks the birds assumed an upright attitude, the whole of the leg and toes being applied to the surface. It was a native of the northern hemisphere, the penguin being its relative in the southern. The causes of its extermination are not difficult to discover. Its short wings and peculiar conformation rendered it helpless on the land; while its flesh and feathers were so valuable as to invite the rapacity of man. There were few suitable breeding-places, and when these were invaded it could not fly elsewhere, and had no choice but to die. In the 'struggle for existence,' to which nature subjects all her animated productions, such a bird as the great auk must perish early. It must have been a curious sight, two hundred years ago, to see these wild, lonely islands, their coasts literally swarming with these strange birds, as they waddled slowly about in an erect position, with their broad webbed feet and short wings, resembling the flippers of a seal. They were the connecting link between the fish and bird, partaking of the nature of both. The *English Pilot* for 1774 thus refers to them: 'They never go beyond the Banks as others do, for they are always on it or within it, several of them together. They are large fowls about the size of the goose, a coal-black head and back, with a white spot under one of their eyes, which nature has ordered to be under their right eye, an extraordinary mark. These birds never fly, for their wings are very short, and most like the fins of a fish, having nothing upon them but a sort of down and short feathers.' Not only were the crews of the fishing vessels of those days in the habit of consuming vast quantities of these birds' flesh, but they were accustomed to salt down many tons of them for future use. The merchants of Bonavista and other places were in the habit of salting and selling them, in the winter season, instead of pork, to the fishermen. The sailors used to land on the islands where they bred and fill their boats with the plump unwieldy birds (which on land could make no effort to escape), driving them, according to Whitbourne, on board by hundreds, or knocking them on the head with sticks. They feasted on their eggs and even burned their bodies for fuel in order to warm water to pick off the feathers, which were very valuable. After slaughtering them they sometimes shut them up in stone enclosures in order to have them ready when wanted. It is not wonderful that under such circumstances the great auk has been completely exterminated."

We wish the Penguin islands had been indicated on the map, and also the Funk islands, which we suppose to be the Fogo island. It is to be hoped that Mr. Harvey may elicit more information regarding the former existence of the great auk, though without doubt it ranged along the southern coast of Newfound-

land, Nova Scotia, and extended as far south as Cape Cod, as its bones are found in Indian shell-heaps at Ipswich, Mass., as well as the coast of Maine, and it was noticed by Josslyn, who called it the "wobble" (AMER. NAT., Vol. I, p. 578).

The chapters on the fisheries, on Labrador, those on the agricultural and mineral resources, etc., are all to the purpose. The best game animal is the caribou, which still in vast herds traverses the island in periodical migrations from north to south; the moose is still common, and there is good salmon fishing. The accompanying plate is a fair sample of the illustrations.

When the railroad to Notre Dame bay shall have been completed, a new era in the prosperity of Newfoundland will be opened, and when the railroad to Cape Ray, connecting the short sea route, is built, it will doubtless be very popular, and confer great local benefits by bringing the island into daily communication with Europe and America.

WRIGHT'S ANIMAL LIFE.[1]—In preparing this work the author has kept in view the wants of a large class of persons who like to see good pictures of animals and to read anecdotes about them. The popular idea of an "animal" is a beast or quadruped, or a bird, or reptile, or fish. There are those still existing to whom an insect is an insect, but perhaps not an "animal;" coral polyps and the multitudes of species of worms and other invertebrates are as unknown to them as the inhabitants of the planet Mars. Such persons were "brought up" on Goldsmith's Animal Kingdom, and when they buy for themselves or their children an Animal Kingdom, they want a modern Goldsmith. In other words they desire and expect to buy a bibliothecal Noah's ark with all its animals, which is well known were confined to such terrestrial forms as the celebrated voyager and his limited family could conveniently gather when their time was not otherwise engaged in preparing for their momentous voyage. The innumerable creatures of the seas through which the Noachian craft leisurely ploughed, were regarded with as little interest by the early voyagers (who soon became sick of the sea and all that belonged to it) as the general reader of to day looks upon Porifera, Cœlenterates, Echinoderms, Vermes, Brachiopods, Polyzoa or Tunicates. They are to him little more than names of illy-understood groups which he supposes to be of but little importance, whereas if it had not been for the worms we should have had no vertebrates at all, much less readers of an "Animal Kingdom."

Professor Wright has shrewdly adapted his book to this class of readers. He begins with mammals, then takes up the birds, and devotes two-thirds of the volume to these two classes. Considerable space is given to the reptiles, amphibians and fishes;

[1] *Animal Life. Being the Natural History of Animals.* By E. PERCIVAL WRIGHT. With Illustrations. Cassell, Petter, Galpin & Co., London, Paris and New York. 8vo, pp. 618.

sixty pages out of 618 are given to insects, and less than a hundred are reserved for all the other classes of the animal kingdom. The result is a well-written, profusely-illustrated and well-bound story book, which would make an admirable present to a lad interested in natural history. The value of such books is considerable, and the author has succeeded admirably in his task.

With much to commend in the treatment of his subject, we could, however, have wished for a more modern rendering of zoölogical science, especially those facts and laws relating to the struggle for existence, the relations of animals to each other and to their surroundings, as well as protective mimicry and the like topics. It is evident that the author has not been inoculated with the ideas and discoveries of modern biology; hence there is yet room for a skilfully written popular sketch of creation.

The author deprecates any criticism from specialists, so that fault-finding with his classification would be ungracious, though we must say that his arrangement of the insects, the Crustacea and Mollusca is unnecessarily old-fashioned. The average reader would find the work just as interesting if it had been in this respect made more in accordance with modern views.

The book is, however, a very entertaining one, with one or more well selected illustrations on nearly every page, and the stories are well told, so that the publishers may feel well satisfied with the way in which the author has accomplished what is, at best, a difficult task.

CHRIST'S FLORA OF SWITZERLAND AND ITS ORIGIN.[1]—This important work, which we have received through the kindness of the author, is one that we think destined to attract much attention. It is addressed not only to professional botanists but to cultivated people everywhere. Many Americans visit the little republic every year, led by its unequaled natural attractions. To such this book will prove invaluable. It is not a flora in the commonly accepted sense, that is, a list and description of all the plants of the region. On the contrary, it is an extended and painstaking treatise on the phyto-geography of the country; the origin, history and development of the vegetable growth.

The author has given many years of assiduous labor to the work, and writes not only with polished grace but with evident devotion. In fact, we have found ourselves quite carried away by some of his graphic descriptions.

The author treats minutely of the zones of distribution and the causes which act upon them, and one who reads it carefully can hardly fail to acquire increased and useful information on a great variety of botanical subjects. Accompanying the work, which is one of 571 pages octavo, are five beautiful maps in color, showing vegetable distribution, and four full-page illustrations of char-

[1] *Flore de la Suisse et ses origines.* Par le Dr. H. CHRIST, Bale.

acteristic regional plants. It is a real treat to look over a book so entertaining in itself and so sumptuously prepared. The indices, those all-important adjuncts of any scientific work, not only include the names of plants, but of the insects visiting them, and of localities. We most heartily commend the volume to our fellow-workers.

We might add that we know from experience that Dr. Christ is an excellent collector. He is now especially interested in the genus Carex and in Coniferæ, and desires to exchange with American botanists. Those who are fortunate enough to effect an exchange with him will get more than an equivalent for what they send in varieties from the Alps superbly prepared.—*W. W. Bailey.*

BUCKLEY'S WINNERS IN LIFE'S RACE.[1]—We may say without qualification that this is the most successful attempt at a popular

sketch of modern zoölogy with which we are acquainted. The authoress has been fortunate in her sources of information and in her artists. She wields an easy and graceful pen, has the art of

[1] *The Winners in Life's Race, or the Great Back-boned Family.* By ARABELLA B. BUCKLEY. New York, D. Appleton & Co., 1883. 12mo, pp. 367. $1.50.

THE EARLIEST KNOWN WATERBIRDS

THE FIRST KNOWN LAND BIRD

vivid description and good generalizing powers. It is, moreover, a successful application of the principle of evolution, the theory forming the warp and woof of the work, and thus according with nature, while a wholesome and reverent tone pervades the pages. It is just the book to use in schools as a reader, or for collateral reading by classes in zoölogy.

The book is a continuation of Miss Buckley's earlier little volume entitled "Life and her Children," to which we shall hereafter draw attention. Taking up the thread dropped at the close of the

book just named, the authoress shows that while the world before the advent of fishes and other back-boned animals was teeming with life, worms, mollusks, crustaceans, insects, etc., yet the world could not make the fullest use of them, and therefore life devised a plan of structure where her forms should reach their highest expression, and which should take the lead all over the earth, dominating the regions of the air, the earth, as well as the water.

Beginning with the lancelet, and considering the sea-squirts or ascidians, two types lying on the threshhold of "back-bone life," she then describes the lamprey, then the old-fashioned "ganoid" fishes, and shows how they led the way to the incoming of the

amphibians, the reptiles, birds, the bony fishes, and lastly the mammals, with man, "the last and greatest winner in life's races."

The story is most skillfully told; it will charm the grown-up naturalist, and, as we have reason to know, interest an intelligent lad. The wood-cuts, some of which we reproduce, are by Mr. Carreras, and are geological restorations of unusual excellence. The frontispiece, illustrating the phosphorescent fishes, is by Mr. Smit. The authoress acknowledges the aid of Professor W. Kitchen Parker, Mr. Alfred R. Wallace and others, and her work while very readable is also reliable. We can see no points open to serious criticism.

BAUME'S ODONTOLOGICAL RESEARCHES[1]—This is not a systematic work on odontology, but a series of chapters on the general nature of teeth, containing the results of the author's original researches, and well illustrated by numerous wood-cuts. The first part is an attempt at a developmental history of the teeth. After stating the nature of the theory of natural selection, the author enters into an elaborate general description of the dermal armor of vertebrates, which is followed by descriptions of the placoid scales and teeth, and the teeth of other fishes, as well as those of amphibians and reptiles, and a section on the development of mammalian teeth. The following subjects are then discussed: the reduction of the teeth; the strengthening in their sockets of mammalian teeth, especially the relations between the teeth and bones; the hard tissues of teeth; the physiology of dental substance; the ever-growing teeth (wurzellose zähne) of mammals, *i. e.*, those with an exposed pulp, as the incisors of rodents, and the tusks of the elephant; the formation of the crown and root; the specialized teeth; the transformation of tooth-forms; the milk-teeth; the diphyodont semblance of mammals; the third dentition; the typical number of mammalian teeth of the present time; the last rudiments of lost teeth in the jaws of other mammals, and finally he discusses teeth and their organism.

The second part is of more practical interest, discussing the defects of the hard parts.

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[1] *Odontological Forschungen.* Von ROBERT BAUME. Leipzig, Verlag von Arthur Felix, 1882. 8vo, pp. 307, 191.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—The Athabasca fur district, acccording to the Rev. E. Petitot, contains large areas of fertile ground capable of supporting a considerable population. One of these areas is the delta formed by the mouths of the Athabasca and Peace rivers, at their entrance into Athabasca lake. Between Egg river, by which the Peace river enters the lake, and Duck portage on the Slave river, is an immense plain, intersected by rivulets and by the openings from the Peace to the Slave rivers. This delta is comparable in fertility with that of the Comargue in Provence. Besides these deltas, the zone of natural prairie along the Rocky mountains from the Upper Saskatschewan to the Hay river, comprises every condition necessary for settlement.

The Athabasca rises in a little lake at the foot of Mt. Brown (16,000 feet). Its course before entering Athabasca lake must be 500 to 600 miles. The passage between Athabasca and Great Slave lakes, known as Slave river, is 240 miles long, while the Mackenzie, as the river is called between the Great Slave lake and the ocean, is about 1045 miles in length. On the Athabasca proper, near the confluence of the Clear-water, is a chain of little volcanic cones, and in this district "boucanes," or vents, giving forth smoke and fire, abound. These are usually found on the line of deposits of incompletely carbonized lignite. Where the Athabasca meets Birch or Bark mountains there is a cañon some twenty-five to twenty-eight leagues long, called the Great Rapid, followed by several other rapids. There is no fall, but a rapid, flat sheet of water, obstructed by enormous boulders. At this part erosion has detached from the rocks a multitude of lenticular concretions varying from the size of a button to that of a large boat. Fossils abound in the shelly limestone that alternates with the bituminous schists.

Lake Athabasca, though the smallest of the great chain of lakes that stretches from the Gulf of St. Lawrence to the Arctic, is 230 miles long by twenty wide. Its bed is deep, and its banks granitic on three sides; but there are sandy or muddy deposits on its southern shore. Its northern side is wholly sterile and rocky, affording food to nothing but caribou.

M. Petitot's paper and map correct four geographical errors.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Lake La Rouge, which drains into the Churchill, but was said to also open into the Beaver river, is shown not to do so, as the La Plonge river, though it rises near Lake La Rouge and falls into the Beaver, does not take the waters of the lake. Lake Wollaston does not, as was supposed by Hearne, communicate with Lake Athabasca. The most southerly stream that flows into the latter lake rises at the foot of Beasts mountain, close to Lake Wollaston, but has no communication with it. Great Bear lake, supposed by Sir J. Richardson to have three outlets, viz., Bear Lake and Hareskin rivers, entering the Mackenzie, and Beghula river, flowing to the Arctic, has really but one—that which bears the same name. The Hareskin river flows out of the Wind lake near Smith bay in Bear lake, and the Beghula or Anderson rises in a little lake at the foot of Mount Ti-dépay, quite to the north and some distance from Bear lake. The fourth error regards the famous great lake of the Eskimo, now known to be considerably smaller than was supposed. This lake was believed to have various openings into the Arctic, besides one in the mouths of the Mackenzie and another in the Anderson. It is now known that this lake has but one outlet, the "Natowdja," which flows direct into the Arctic ocean. M. Petitot represents the Beaver and Unknown rivers, which enter Lake Athabasca from the south, as of rather large size, and as rising in lakes near the drainage of the Churchill.

The Indians of the Athabasca and Mackenzie districts, chiefly Chipewyans and Crees, are so reduced that they barely reach 6000.

A Visit to Stanley's Stations in Africa.—Mr. H. H. Johnston gives (Proc. Roy. Geog. Soc., Oct., 1883) an interesting account of his trip up the Congo to Mr. Stanley's stations. Mr. Johnston first made an excursion from Underhill, a Baptist station on the Lower Congo, to Pallaballa. The villages upon the Lower Congo have a comfortable look, and the natives raise maize, cascada, limes, sometimes oranges, papaws, the passion flower, which gives the fruit known as maracuja or grenadilla, and bananas and plantains. The plots of garden are marked out by a line of bast tied from peg to peg, just as our gardeners do with a string; hens are kept in hen-coops made of withes and grass, and goats and sheep are housed in a shanty of palm-fronds. The Central African sheep have short hairy coats, and the rams have also a silky mane from chin to stomach. Here and there may be seen a black, high-shouldered bullock stalled in a not ill-fashioned manger of palm-fronds.

The houses are built neatly and well, and are usually raised a foot above the ground on a platform of beaten earth. They are made of stout poles, with a wide-spreading roof having a long pole in the center, and covered with thin laths and dried grass. The roof extends some feet beyond the house all round, and is

prolonged in front into a kind of veranda, where the inmates of the dwelling pass most of their time.

The scenery on the road to Pallaballa, as usual in the cataract region of the Congo, consists of grass-covered hills alternating with fertile valleys. Pallaballa is on the crest of a hill 1600 feet high, and is a station of the Livingston Inland Mission.

Many Portuguese words are introduced into the dialect. A prevailing superstition among the natives causes some person to be considered as *udokki*, or devil-possessed, whenever any one dies. The *udokki* must take the *casca* poison, which is, however, usually administered so as to be a strong emetic, under the notion that he will "bring up" the devil.

The young men undergo an initiation of six months, during which time they are called *inkimba;* do not wash any part of their bodies, and are chalked all over a ghastly white. The initiation has three or more stages. The *nganga*, or medicine-man, teaches them a distinct language, which is never taught to females.

Returning to Vivi, Mr. Johnston walked thence for Isangila (fifty-eight miles), a station facing the rapids of the Congo. The next station, Manyanga, is eighty miles further, and Leopoldville, on Stanley Pool, is ninety-five miles beyond Manyanga. The scenery between Manyanga and Leopoldville is beautiful. Stanley Pool is an expansion of the Congo, about twenty-five miles long by sixteen broad, with seventeen large islands and many floating islets formed of masses of aquatic vegetation. Around the cup-like basin of the pool is an incomplete rim of picturesque mountains, not rising above 4000 feet. The scenery is especially beautiful at the northern end, where the Upper Congo enters the pool. Further south the banks are lower, as the mountains recede from the water. "Brazzaville," or rather Mfwa, has no advantages as a site, and is a small, low-lying native village. Opposite to it a curious cliff, apparently of red clay, rises some fifty feet above the river. This is called Calina point, from Lieut. Calina, who was recently drowned in the dangerous current that sweeps around the promontory. This point belongs to the natives of a large village called Kinshasha, and these have hitherto refused to allow either Stanley or De Brazza to erect a station there. The latter, it is rumored, covets this point, and intends to fortify it, so that with it and with Mfwa opposite he could close the exit from Stanley Pool to the Lower Congo.

From Leopoldville our traveler ascended to Bolobó, 250 miles farther up the river. Above the pool the Congo varies in width from 600 to 1000 yards. Msuata, 110 miles from Leopoldville, is one of the prettiest of Mr. Stanley's stations, and is surrounded by natives who are very cordial to Europeans. Farther on is Ganchu, the "pirates' village" of Stanley's first descent of the river—so-called through misconception of the peaceful intentions

of the natives. The Wabuma, a stream at its mouth as wide as the Thames at Westminster, flows, according to Stanley, out of a lake seventy miles long (Lake Leopold II), runs for a great part of its course nearly parallel with the Congo, then bends away and broadens greatly, and finally contracts at its mouth. The Quango is probably an affluent of the Wabuma. The Bayansi village at the junction of Wabuma and the Congo has compact, tidy-looking houses, some containing three rooms.

The principal tribes between Bólóbó and Stanley pool are the Batéké, the Bayansi, and the Wabuma. All seem to be comparatively recent arrivals. The first are resident colonists from the north-west, between the Ogowé and the Congo; the second come from the Equator and north-east, and are the great travelers and traders of the Upper Congo, while the third inhabit the lower course of the river of the same name. All are kindly, merry, and courteous in behavior, of splendid physical development, and possessed of great artistic power, as shown in the decorations (often indelicate) of their utensils and arms. They are fond of music, and from their five-stringed instruments draw many harmonies of plaintive tone and perfect rhythm. The languages are of the Bantu stock,, and that of the Wabuma is strangely guttural. All have many words identical with the Kaffir tongues. Zanzibaris can often make themselves understood.

Asia and the Indian Archipelago.—Mr. H. O. Forbes has returned to London after five years of wanderings. He first visited the Keeling island in the South Indian ocean, and then, proceeding to Java, explored its western and southern districts, making numerous observations on the fertilization of orchids, etc. He then spent eighteen months in Sumatra, making botanical collections, ascending and measuring the highest peaks of the Barisan range, visiting the elevated plateau of Blalauw, and staying awhile with a pagan race inhabiting the Passoemah lands round the Dempo volcano. The customs of this people differ widely from those of the surrounding peoples, and Mr. Forbes found there two hideously visaged sculptured figures. He also visited the forest-living Kœboes, supposed to be the remnants of the indigenes. Afterwards, accompanied by his wife, he visited the till then unexplored Timor-laut, and lastly traversed the eastern part of Timor.

According to Mr. R. Lydekker, of the Geological Survey of India, the deepest by far of the Indian River valleys is that of the Indus below Bowanji in Gilgit. Between that place and the Darel district, Lt. Col. H. C. B. Tanner states that the Indus flows in a narrow gorge bordered by precipices 20,000 feet in height above the ocean level, the level of the waters being a little over 3000 feet, thus giving nearly 17,000 feet as the actual depth of the gorge. The occurrence of river gravels and honey-combed rock surfaces

many hundreds of feet below the present level proves that a great part of this gorge has been cut by the river itself.

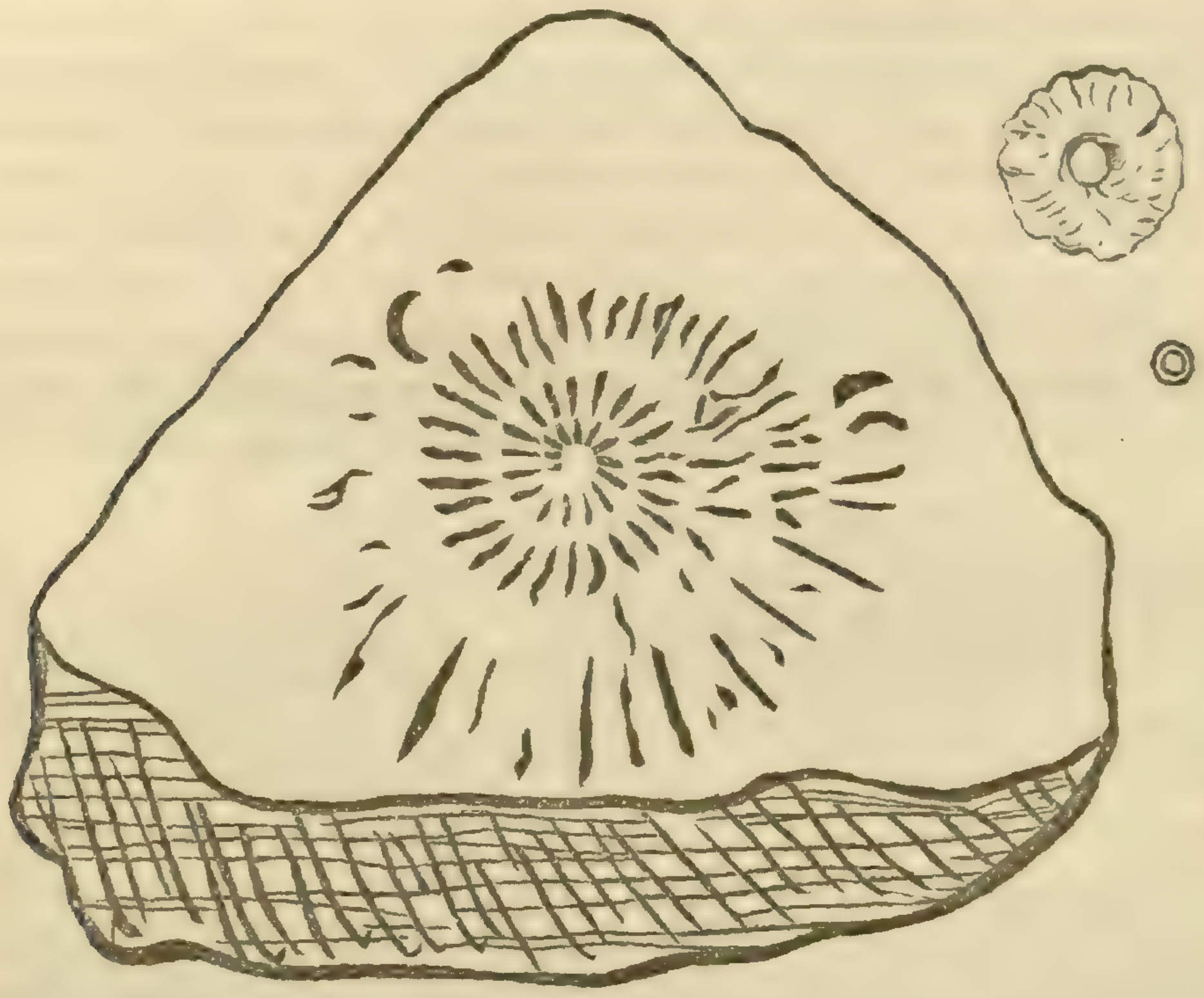
The lowest level of any Himalayan glacier is 9400 feet, at which point one of the glaciers about the Peak of Nanga-Parbat terminates, near the village of Tarshing. The most southern of the Mastagh or Kárákoram range (which contains the second highest known peak of the world, 28,000 feet) is covered with a complete network of glaciers, some of which (the Biafo and Bráldu glaciers) are only exceeded in size by the great Humboldt glacier of Greenland. The lowest limit of these glaciers is about 10,000 feet, and, contrary to what occurs in other parts of Káshmir, they descend quite into cultivated ground, and their terminal moraines are frequently covered with a thick growth of cypress.

Geographical Notes.—A letter from Mr. Stanley, dated July 14, reports the discovery of a new lake called Mantumba, and also the exploration of the course of the River Ikelembu, which is identical with the Malundu, and is a broad navigable stream. Mr. Stanley expresses increasing surprise at the density of the population in the equatorial parts of the Congo basin, and estimates the inhabitants of that basin at forty-five millions.——Dr. Stecker has returned to Germany after five years' travel in Africa. During this period, beside his journeyings in company with Dr. Gerhard Rohlfs, he discovered, east and south of Abyssinia, about a dozen countries which had not previously been visited by any European. He was imprisoned as a spy by King Melelek, of Shoa, but was released through the intercession of Marquis Antinori.——The East Siberian branch of the Russian Geographical Society is exploring the vicinity of Lake Baikal, where rich remains of the stone age are found. The Valley of Tunka seems to have been an immense workshop for the fabrication of quartz, jade and nephrite implements. The Valley of the Angara consists of a succession of large plains separated by narrow gorges. The Valley of Tunka was occupied by a series of lakes in the Post-pliocene period. On the Steppe of Ust-Unga M. Agapitoff has found a spot where thousands of implements could be collected. Pieces cover the steppe over a space of more than twelve miles. The stone hatchets of the steppe are similar to those in use among the Chukches.——Great results may be expected from the proposed expedition of Col. Prejevalsky to Thibet. He will be absent two or three years, during which time he hopes to explore the country of the Si Fans, between Lake Kookoo-nor and Batung, to traverse Northern Thibet and, if possible, follow up the Brahmaputra.——The last census of Bohemia gave the number of Czechs as 3,470,252, that of the Germans as 2,054,174. The number of foreigners in Bohemia is only 80,236, and consists chiefly of Germans. The Czech nationality preponderates in the center of Bohemia, in some districts to the almost total exclusion of the German element, but in the border districts,

especially those of the north-west, the Germans preponderate. ——M. Lessup has written to the Russian Geographical Society that he has explored the Ongouz river, which was previously known only in the upper parts. Even the Tekkes did not know the route to the east of Mirza-chile.

GEOLOGY AND PALÆONTOLOGY.

THE POWER OF MOTION IN CRINOID STEMS.—At the Soldiers' Home, near Dayton, Ohio, I found the stone here figured. Imbedded on its upper surface lay a coil of crinoid joints in such a way as to indicate that they had all once formed part of the same crinoid stem. Indeed, the former unity of the first 2½ coils is evident; but here we find traces of two coils, and a little farther out is seen a half coil of larger beads, however the parallelism of



Coil of Crinoid Joints.

the coils would indicate that these are only parts of the same stem, the intermediate parts having been removed and their connection broken.

The stone is of the Clinton group, but I cannot determine the species of the crinoid; although separate joints of the stem are extremely common, the crinoid heads are lacking. One thing is remarkable, the rapid increase in size of the joints of the column within 2½ coils, or not quite three inches, from $\frac{1}{16}$ of an inch to about four times this diameter. I figure the end disks, enlarged two diameters.

The column is disposed in a perfect and natural coil. It is not customary to find things so arranged in nature unless it is either a law of their growth or the objects have the power of volition and can place themselves in such a position at will. The first

case is not true here, because I frequently find a few continuous joints which do not show this coiled arrangement. It cannot be mere accident, since it is almost mathematically perfect, and any agency at work upon the animal after death, such as the rotary movement of water in a whirlpool, or the play of animals, might have twisted the crinoid about, but would not have formed a coil such as this. Hence, I conclude that it must have had the power of placing itself in this position at will, and that it was destroyed at a time when it had so disposed itself. The power of assuming the shape of a coil is quite a complex one, and necessitates a system of muscles capable of slight contraction along the whole extent of the column, and is generally correlated with power of motion in any direction, as in the bodies of snakes and the necks of swans.

So we may conceive the head of our crinoid as attached to this column and through it to some object on the bottom of the ocean; but it is not a flower dangling on its stem, dependent on the capricious flow of water and the accidental presence of animalcules for its food, but we may picture it as moving about in all directions, limited indeed by the length of its column, and thus securing its food. I have been quite lengthy in my description, but this may be excused if I have convinced my geological friends on this subject.—*Aug. F. Foerste, Dayton, Ohio.*

The Loup Fork beds on the Gila river.—In his report on the Geology of New Mexico, to the Secretary of the Interior, by Dr. F. V. Hayden, in 1869, this eminent geologist described the Santa Fé marls in their principal physical features. In 1874, in my report to Capt. Geo. M. Wheeler, U. S. Engineers, I showed that this formation is a member of the Loup Fork division of the Miocene Tertiary, a conclusion clearly deducible from the remains of Vertebrata which it contains. An illustrated report on the latter was published in the fourth volume of the Report of the U. S. Geographical and Geological Survey W. of the 100th meridian, Capt G. M. Wheeler in charge (1877).

Since that time the writer has made several visits to parts of New Mexico not previously explored, and I am able to show that the Loup Fork formation has a much wider distribution in that territory than has hitherto been supposed to be the case.

In descending the Rio Grande, beds appear on the west side of the river, which strongly resemble those of Santa Fé. They extend along the eastern base of the Magdalena mountains, and as far south as Socorro, in considerable extent and thickness. South of Socorro they appear, but less extensively. The eastern part of the plain which lies between the Rio Grande and Mimbres mountains is composed of beds of this age where cut by the grade of the Atchison, Topeka and Santa Fé R. R. west of Hatch station. West of the Mimbres mountains the valley of the river of the same name is filled with débris of the bed of eruptive out-

flow which once covered the country as far as traversed by the railroad from Deming to Silver City. Its age I could not ascertain.

A great display of the Loup Fork formation is seen in the drainage basins of the heads of the Gila river. In traveling westward from Silver City, its beds first appear in the valley of Mangus creek, which enters the Gila from the east. Crossing the Gila, the mail route to the west passes through the valley of Duck creek, which flows eastwards into that river. Though bounded by eruptive hills and mountains, and their outflows, the valley was once filled with Loup Fork beds, which have been extensively eroded, the principal exposures being on the north side of the valley, forming the foothills of the Mogollon range. On the divide between the waters of the Gila and San Francisco rivers, the formation rises in bluffs of 300 feet elevation. The descent into the valley of the San Francisco brings to light a still greater depth of this deposit. The valley, which extends from the cañon which encloses the river south from the mouth of Dry creek, to the Tulerosa mountains on the north, and between the Mogollons on the east and the San Francisco range on the west, was once filled with the deposit of a Loup Fork lake. This mass has been reduced by the erosive action of the San Francisco and its drainage, to a greater or less extent, as it has been protected by basaltic outflows or not. When so protected, the river flows through comparatively narrow cañons. Where the outflow is wanting, the valley of the river is wider, and the Loup Fork formation remains as wide grassy mesas which extend to the feet of the mountain ranges.

The age of these beds would have remained problematical but for the fortunate discovery, by Mr. Robert Seip, of the skull of a species of rhinoceros of the typical Loup Fork genus Aphelops. It is apparently the *A. fossiger* Cope, a species abundant in the Loup Fork beds of Kansas and Nebraska. It was found near the mouth of Dry creek, in a conglomerate bed of the formation.

In the valley of the San Francisco, the Loup Fork beds reach a thickness of 500 feet, and consist of sand, clayey sand, soft sandstone and conglomerates of larger and smaller pebbles of eruptive material, having a near resemblance to those of the region of Santa Fé.—*E. D. Cope.*

On new Lemuroids from the Puerco formation.—The animals of the Eocene period, of the Adapidæ, may belong to the Lemuroidea, but the evidence which I have derived from the feet of Pelycodus[1] has led me to refer them[2] to the insectivorous division of the Bunotheria, to the neighborhood of the Tupæidæ and Erinaceidæ. At the same time I retained provisionally the gen-

[1] Report of U. S. G. G. Survey W. of 100th mer., G. M. Wheeler, IV, p. 140.
[2] Proceedings Academy Nat. Sciences of Philada., 1883, pp. 78–80.

era with three and two superior premolars in the sub-order Lemuroidea, although the foot structure of these extinct genera is yet unknown. I also inadvertently defined the Lemuroidea as having quadritubercular superior molars, a character which I well knew to be wanting in various extinct and recent genera where they are tritubercular. Two families were proposed for the Eocene lemuroids, which are defined as follows:

Superior premolars three.....*Mixodectidæ.*
Superior premolars two.....*Anaptomorphidæ.*

The genera of the first named family are defined as follows:

I. Canine teeth large and lateral; well separated.

First superior premolar without internal lobe; superior true molars tritubercular with cingula.....*Tricentes.*

II. Canine teeth median in position or much reduced in size.

a. Last inferior premolar without internal tubercle.

Inferior premolars all one-rooted. Canine and incisor small.....*Necrolemur.*[1]
First premolar only one-rooted; canine small; incisor very large.....*Mixodectes.*[2]

aa. Last inferior premolar with internal tubercle.

A very large ? canine; first premolar only one-rooted.....*Microsyops.*[3]
A very large ? canine; first and second premolars both one-rooted...*Cynodontomys.*[4]

The new genus Tricentes includes three species, and perhaps four. These are *T. crassicollidens* Cope, *T. bucculentus* (*Mioclænus* Cope), *T. inæquidens* Cope, and *T. subtrigonus* (*Mioclænus* Cope). These species are all represented by more or less complete crania, and are fully described in the Proceedings Amer. Philos. Society for December, 1883. They all have the orbit open behind.

The genera of Anaptomorphidæ, which on dental characters includes Indrodon, differ as follows:

a. Incisors three.

First superior premolar without inner lobe; posterior inner tubercle present on first and second superior true molars.....*Indrodon.*

aa. Incisors two.

First superior premolar with inner lobe; no posterior inner tubercle on superior molars.....*Anaptomorphus.*[2]

The superior dental formula of Indrodon is I., $\frac{3}{3}$; C., $\frac{1}{1}$; P-m., $\frac{4}{4}$; M., $\frac{3}{3}$. The canine is compressed and acute; the third premolar is compressed conic, and has two roots; the fourth premolar has but one external cusp. The external cusps of the true molars are conic and acute, and are connected with the internal cusp by ridges which form a V. Posterior inner cusp distinct on Ms. I. and II, a part of the posterior cingulum. Intermediate tubercles

[1] Filhol Rech. Phosph. Quercy.
[2] Proceedings American Philos. Society, 1883, p. 559.
[3] Leidy, Report U. S. Geol. Survey Terr., 1.
[4] Cope, Pal. Bull., No. 34.

present, small. The superior incisors are well developed and display no tendency towards the rodent type. A portion of lower jaw adheres to the skull, and may belong to the same animal. It supports the last two molars. These have two anterior, opposite, approximated cusps. The heel of the penultimate molar is rather large, and has a raised edge, which develops two tubercles at the angles.

Indrodon malaris, sp. nov.—*Char. Specif.*—The first and third superior incisors are a little larger than the second. Canine preceded and followed by diastemata, each of which is 1.5 times as long as the long diameter of the base of the crown. Premolars separated from each other and from the first true molars by interspaces half as long as the diastemata. Neither tooth has any basal tubercles, but the posterior has a weak external cingulum, which is stronger posteriorly. The internal cusp of the same tooth is anterior, and is acute and elevated. The superior true molars have a strong external cingulum, which rises into a small tubercle opposite the space between the external principal cusps. Of the latter the anterior is a little more conic than the posterior, and both are well within the external border. On the last molar the posterior external cusp is continuous with the external intermediate tubercle, and forms a cutting edge within the posterior margin of the crown. The posterior inner tubercle is rather large, and projects further inwards than the apex of the anterior V or the second true molar, but not so far as in the species of Anisonchus and Haploconus.

The surface of the cranium is too much obscured by cracks and films of matrix to permit a view of the sutures and foramina. The face is wide, as the posterior part of the maxillary and the malar bones are expanded outwards. I have not yet been able to ascertain the condition of the orbit posteriorly. The mandibular ramus is rather slender.

MEASUREMENTS.		M.
Length of dental series from posterior base of I III		.0248
Length of bases of superior incisors		.0060
Length of premolars on maxillary bone		.0060
Length of base of Pm. IV		.0028
Width do.		.0038
Diameters M. II	anteroposterior	.0033
	transverse	.0040
Diameters inferior M. II	anteroposterior	.0032
	transverse	.0030
Depth of ramus mandibuli at M. II		.0070

The skull is about the size of that of the *Bassaris astuta*. New Mexico; D. Baldwin discoverer.

The discovery of this type in the Puerco formation is a fact of interest. In the shortening of its dental series it is the most specialized genus of the epoch, while the forms of its true molars

are like those of the simple Creodonta, and more specialized than those of Anaptomorphus and the lemurs generally. In the simplicity of its premolars, however, it maintains the general character of the Puerco fauna, and is more primitive than the forms just named. Its nearest ally of the Puerco yet known is Chriacus.—*E. D. Cope.*

THE DESTRUCTION OF THE VOLCANO OF KRAKATOA.—It now appears that this volcano was not wholly destroyed during the great eruption on August 26th, a portion of its southern aspect still remaining. How it appeared before the catastrophe may be seen in the accompanying illustration from the *Scientific American*. *Nature* for Oct. 25 prints several communications respecting the great earthquake wave which was felt at Aden, Cape of Good Hope, and the Mauritius. Farther facts of much interest appear in *Nature* for Nov. 8. It seems that on May 22, 1883, Krakatoa was in a state of eruption, sending out showers of ashes and streams of pumice. The activity continued during June and July.

HUNTING FOR LOST GLACIERS WITH A MICROSCOPE.—Considerable work has been done in this direction in Germany and elsewhere, by various observers, work with which geologists are more or less familiar, and Dr. E. Geinitz gives the results of an extended study of the plagioclase rocks and phonolites of the Mechlenburg drift.

The method consists in examining thin sections of the rocks found in the drift, and comparing them with the descriptions given by the Scandinavian lithologists of rocks known *in situ* in that peninsula. In this way various basalts, diabases, gabbros, diorites and phonolites are referred to certain localities in Sweden, whence they are supposed to have been derived. Interesting results can be obtained by such methods, but they are often uncertain, since it cannot be predicted that rocks of the same character do not exist, or have not existed, in the intermediate drift or water-covered areas.—*Journal of R. Microscopical Society.*

GEOLOGICAL NOTES.—*General.*— Professor T. R. Jones, in a report presented to the British Association at its last meeting, gave a synopsis of the fossil Phyllopoda. He recognizes thirty genera, of which seventeen occur in Great Britain.——Mr. Hy. Woodward (*Geol. Mag.*, Oct.) commences a synopsis of the genera and species of carboniferous limestone trilobites. The first paper is almost entirely occupied with the genus Phillipsia, eight species of which are diagnosed. *P. laticaudata* is new, as is also a species referred provisionally to Proetus, under the title of *P. levis*. The second paper (Nov.) diagnoses nine species of Griffithsides, one of which is new.——The Transactions of the Royal Dublin Society contain a monograph of the fossil fishes of the Carboniferous series of Great Britain. Following the intentions

The Volcano of Krakatoa, Straits of Sunda; height, 2700 feet.

of Agassiz, as far as they can be detected by his MS. labels, fifty-nine genera and 163 species are recorded, of which 117 have been obtained at Armagh, Ireland. Fourteen of the genera are founded on the spines of Hybodonts, four generic names denote various peculiar cranial bones and dermal plates, the true anatomical relations of which are as yet unknown, and forty-one are founded on the various forms of teeth of the types Orodus, Petalodus, Cochliodus, Psammodus and Copodus. Mr. Davis states that, judging from analogy, the teeth of Cladodus may have been associated with the spines of Ctenacanthus. The spines of Oracanthus are stated to have probably occupied a lateral position on the head of these elasmobranchs. The worn condition of their apices proves that they were not dorsal, while their solid points, decorated on both sides, show that they were not true dermal plates.

Tertiary.—Mr. Newton (*Geol. Mag.*, October) records the occurrence of the cave hyæna, which, with Professor Boyd Dawkins, he regards as a large variety of *H. crocuta*, in the "Forest Bed" strata of Suffolk, England.

Quaternary.—The alluvial deposits of the Kashmir district are stated by Mr. R. Lydekker to be of vast and varied extent and composition. The town of Kishtwar, in the Chinab valley, is built on one of these deposits, at a level of several hundred feet above the river. The presence of fine clayey and sandy horizontal layers in the valleys, at considerable elevations above the bottom of the valley, prove that a dam once existed lower down the valley, and Mr. Drew has estimated that the great lake of Kashmir must once have stood 2000 feet above the present level of the valley.

MINERALOGY[1].

American Gems and Precious Stones.—Mr. Geo. F. Kunz has contributed to "The Mineral Resources of the United States," published by the Government, an article on American gems and precious stones, of which separate copies have been printed. Mr. Kunz has for some years been connected with Messrs. Tiffany and Co., the well known jewelers of New York city, and has had an excellent opportunity for collecting facts concerning American gems.

He states that systematic mining for gems and precious stones is being carried on at only two places in the United States, viz., Paris, Maine, and Stony Point, North Carolina. In other cases where gems are found they are either met with accidentally, or occur in connection with other materials that are being mined, or in small veins which are only occasionally met with. They are often gathered with little system on the surface, as is the case with

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

the sapphire, garnet and olivine found in Montana and New Mexico; or from the beds of streams and decomposing rock, as the moss agate from Colorado; or on beaches, as the agate, chlorastrolite and thomsonite from Lake Superior.

Some eighty-eight different minerals occur in the United States which have been used as gems. Twelve of these occur in the the United States only.

Diamonds are not mined in this country, although they have occasionally been found at a number of localities. A large diamond was found at Manchester, opposite Richmond, Va., by a laborer employed in grading one of the streets. It was an octahedron, and weighed, after it was cut, over ten karats. It was worth $5000 before cutting. The principal localities for *sapphires* and *rubies* are in New Mexico, Arizona, and Southern Colorado, where they occur in the sand, often on ant-hills. *Garnets* occur in the same region, about $5000 worth of cut stones being annually produced. It is estimated that the value of the *tourmalines* taken from Mt. Mica, Maine, is between $50,000 and $65,000. Tourmaline and *hiddenite* are being regularly mined at Stony Point, N. C., some $7500 worth having already been sold. *Rock crystal* is gathered and cut in large quantities, the sales at different localities probably amounting to $40,000 annually. Much of it is cut for jewelry, as "Lake George" or "Cape May" "diamonds." The clear crystal for optical purposes is almost entirely Brazilian, as the good material found here rarely reaches the proper channels. Although *agates* are abundant here, nearly all the polished specimens sold in America have been polished in Germany, having originally came from Brazil and Uraguay. *Moss agates*, however, are collected here in large quantities, although the cutting is done abroad. The *sunstone* and *moonstone* from Pennsylvania and Virginia is of good quality, although as yet used but little. The American *turquoise* is of much interest, but is not much used by jewelers. It is frequently blue when found, but soon turns green on exposure. *Jet* occurs in Colorado and Texas, and will probably soon be utilized in the arts. The *Bowenite* of Rhode Island, and the *Williamsite* of Pennsylvania, are used as a substitute for jade.

A large number of minerals have been cut and used as gems or ornaments, and Mr. Kunz's article will be of service in stimulating more systematic search for the precious minerals. It could be wished, perhaps, that the article referred to was more complete as to localities, but this will doubtedless be rectified in another year's report.

In stating that sphene does not occur as a gem in the United States, Mr. Kunz has evidently not been aware of the beautiful, transparent yellow crystals, often of large size, which occur in Delaware county, Pennsylvania.

A NEW MINERAL.—Under the name of *richellite* MM. Cesaro and Despret[1] have described a supposed new mineral from Richelle, near Visé, Belgium. It is regarded as a hydrous fluo-phosphate of iron and calcium, and is a compact, soft, earthy substance of pale yellowish color and greasy luster, having a hardness of 2–3 and specific gravity 2. The composition is

PO_5	Fe_2O_3	Al_2O_3	CaO	H_2O
28.67	28.71	1.80	5.64	35.54

Of the water, 23.33 per cent is driven off at 100°. Further examination is needed to show that the mineral is homogeneous and a good species.

GEMS FROM THE HIMALAYA MOUNTAINS.—Professor C. U. Shepard[2] has called attention to the discovery of a remarkable locality for sapphire and ruby in the Himalaya mountains. The crystals occur with other varieties of corundum in a schistose or slaty rock, and are associated with chlorite. The gems, which are limpid and finely colored, are also finely crystallized. The locality was discovered accidentally, but is now guarded by government troops. Professor Shepard believes that the resemblances between the mode of occurrence of these Indian gems and those found in North and South Carolina are "sufficiently important to encourage the expectation that valuable corundum gems may yet be found in the United States."

Professor Shepard is apparently not aware that a much more full account of this discovery of gems in India was published more than a year ago, by Professor F. R. Mallet, in a paper entitled "On Sapphires recently discovered in the northwest Himalaya."[3]

It is there stated that the correct locality is Padam, east of the village of Machel, Zanskar district, territory of Kashmir. The gems were exposed by a landslide, and occur far up on the mountain at the limit of perpetual snow. Some of the sapphires discovered were a foot in length. A physical and crystallographic description of the crystals is given. In the center of a hexagonal prism of sapphire, a cavity was found, in which were two crystals of tourmaline. Frequently the specimens are coated with a thin white mineral resembling gibbsite.

The crystals are bluish white and translucent, with transparent fine blue portions irregularly mixed. These blue portions of course constitute the only valuable parts of the crystals, and are carefully cut out by the lapidaries.

DESCLOIZITE FROM MEXICO.—S. L. Penfield[4] has analyzed a vanadium mineral from near Zacatecas, Mexico, which, while having the physical properties of the mineral recently described

[1] Ann. Soc. Belg., Mem. x, 1883.
[2] *Amer. Jour. Sc.*, Nov., 1883.
[3] Records Geolog. Surv. of India, Vol. xv, Part 2, p. 138.
[4] *Amer. Jour. Sc.*, Nov., 1883.

by A. Frenzel under the name of *tritochorite*, appears to be undoubted descloizite. The very small crystals, grouped somewhat like the common crystallizations of calamine or prehnite, had a columnar fibrous structure, distinct columnar cleavage, dark-brown color and resinous luster, with hardness 3.5, and specific gravity 6.200.

Before the blowpipe it gave reactions for vanadium, arsenic, lead, copper and zinc, and in the closed tube it fused readily, boiled up violently and gave off water.

A careful analysis gave

V_2O_5	As_2O_5	P_2O_5	PbO	CuO	ZnO	H_2O
18.95	3.82	0.18	54.93	6.74	12.24	2.70

It differs from descloizite in having part of the vanadic acid replaced by arsenic acid. The analyses, as well as all the physical properties of the mineral, show such a close resemblance to tritochorite that it is very possible that they are identical, and should both be considered as arsenical varieties of descloizite.

Gold in North Carolina.—At a recent meeting of the Academy of Natural Sciences Professor H. Carvill Lewis exhibited some remarkable gold nuggets found in Montgomery county, N. C., forty miles east of Charlotte and two miles from Yadkin river. Some of the nuggets were of great size. One of them weighed over four pounds, and contained nearly $1000 worth of gold. It was finer than any specimen in the collection at the U. S. Mint, and was probably one of the largest nuggets ever found in Eastern America. Many of the specimens exhibited were of nearly pure gold of a crystalline structure, and of a fine golden yellow color. It was stated that in the district of North Carolina, whence these nuggets were taken, gold is very abundant. The larger nuggets were found in the gulleys, where they had been washed out of the decomposed rock, and it had been stated that a shovelful of dirt dug out of the hillsides anywhere in the district would pan out traces of gold. Some years ago one man took out of a hole sixteen feet square $30,000 worth of the precious metal. The quartzite containing the gold occurs in a white clay or decomposed schist.

BOTANY.[1]

An Interesting Botanic Relic of the District of Columbia.[2]—At a meeting of the Biological Society of Washington, held October 19th, Mr. Lester F. Ward exhibited the original manuscript proceedings of the Washington Botanical Society, which had accidentally fallen into his hands. This society was formed in the year 1817 and continued in existence until 1826. It

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

[2] Communicated by Mr. Lester F. Ward.

numbered among its founders and most active members Rev. Dr. James Laurie, Dr. Alex. McWilliams and Dr. John A. Brereton, while Dr. Bigelow, of Boston, and Doctors Darlington and Barton, of Pennsylvania, were honorary members. Four years after the dissolution of this society Dr. Brereton published his "Floræ Columbianæ Prodomus," in the preface of which he briefly alludes to it. This work is still extant, and an analysis of its contents may be found in Mr. Ward's recently published "Flora of Washington."[1]

This allusion of Dr. Brereton was about all that was known of the history of the botanical society prior to the discovery of the above-mentioned document, which, containing as it does the names of all its members, its constitution and by-laws, and a careful record of all its work in the study of a then unknown and still remarkable flora, possesses great interest for local botanists. Mr. Ward promised that it should be ultimately so disposed of as to render it safe from the vicissitudes of either private individuals or ephemeral societies.

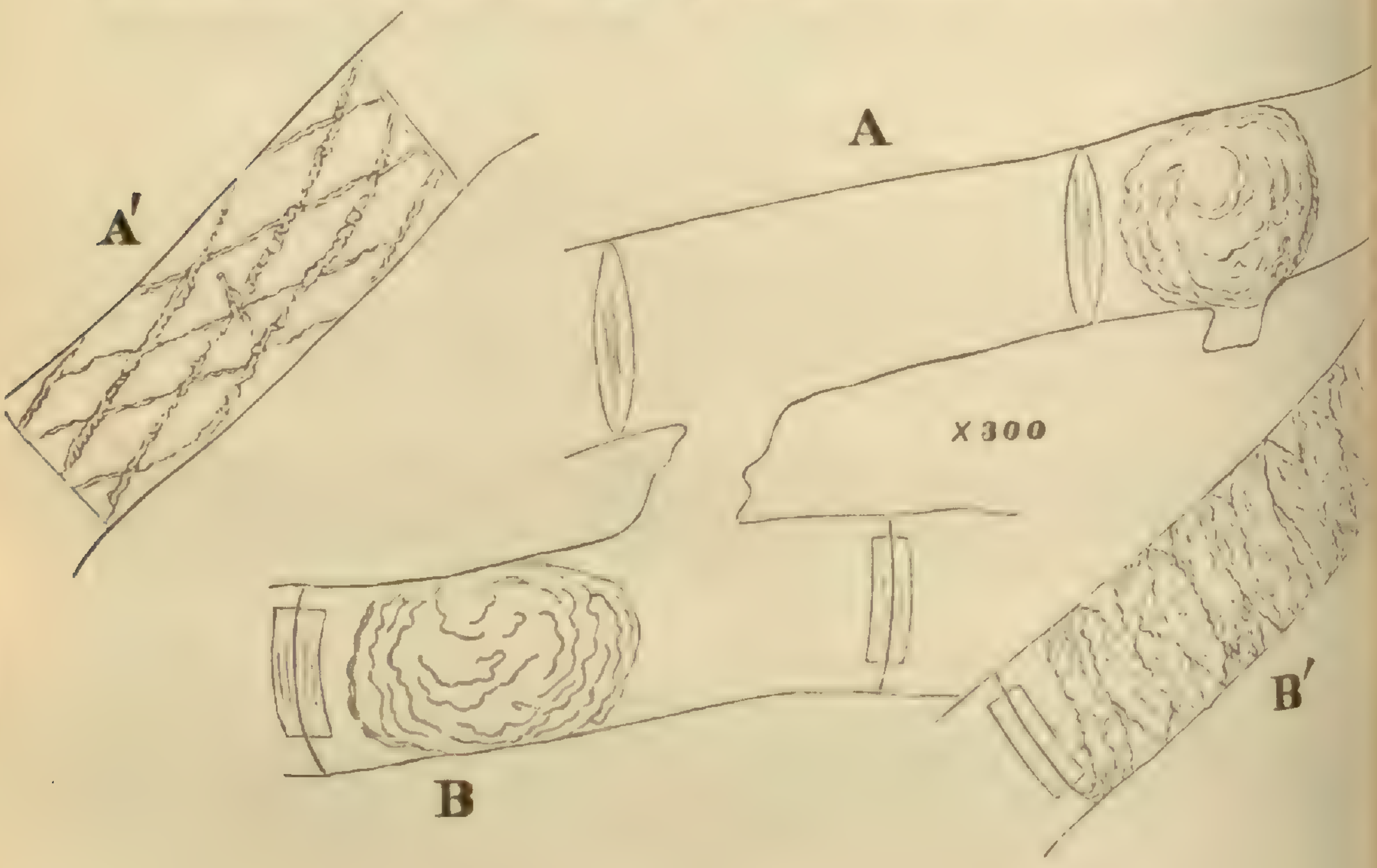
Hybridism in Spirogyra.—An interesting case of hybridism between individuals of two distinct species of Spirogyra came under my observation at Ames, Ia., in August, 1883. The plants of this genus are the familiar pond scums which occur everywhere in ponds and ditches as green stringy growths floating or attached to sticks and stones. Each plant is a long cylinder of cells, and in the latter there may be seen, under a moderate power of the microscope, the beautiful spiral arrangement of the chlorophyll bodies. Sexual reproduction takes place by the union of the protoplasm of two cells. Two plants happening to lie side by side, bud out small short branches which, growing towards each other, finally touch at their tips and then fuse into tubes. Through these tubes the protoplasm from one cell runs into and unites with that in the other. As a result of this union of protoplasm a resting spore (technically a zygospore) is formed. This process may be observed by any one almost any time during the summer, by the aid of a microscope, and there are few things which are more instructive to the beginner in vegetable physiology, who would gain some insight into the real nature of sexual reproduction.

In the case of hybridism under consideration, the two species involved were *Spirogyra majuscula* and *S. protecta.* These species differ from one another so much that there can be no question as to their distinctness. In *S. majuscula* (A and A′ in the figure) there are many very slightly coiled spirals of chlorophyll, the nucleus of the cell is very evident, and the partitions between the cells are plane; in *S. protecta* (B and B′ in the figure) on the contrary, there is but one closely coiled spiral of chlorophyll, the nu-

[1] Guide to the Flora of Washington and its Vicinity. Bulletin No. 22, U. S. National Museum. Washington, Government Printing Office, 1881.

cleus is to be seen with difficulty, if at all, and the partitions have a curious double-infolded appearance.

Two individuals, one bearing all the characters of *S. majuscula*, and the other all those of *S. protecta*, were observed in conjugation, as in the figure. The two species were almost equally abundant in the pool from which the specimen was obtained. As can be seen in the figure an apparently perfect resting spore was formed as a result of the hybridization. It is interesting to note that the form of the resting spore resembles that of *S. protecta*



A, *Spirogyra majuscula*, and B, *S. protecta* in conjugation; A′, a single cell of *S. majuscula* showing structure; B′, a single cell of *S. protecta* showing structure. **(From camera sketches.)**

much more than it does that of *S. majuscula*. The pure-bred resting spores of *S. protecta* in the same pool were much elongated or ellipsoidal, while those of *S. majuscula* were globular. In this instance B was functionally the female and A the male, so that here *form* followed the female.—*C. E. Bessey.*

Large Fungi.—Last summer while searching for small fungi, I found a fungus of unusual dimensions. It was on the trunk of an old tree which was decayed in places. The tree grew where the ground was wet, though not swampy; it was a tall old tree, and the fungus was so high that I could not secure it; but a gentleman found means to reach it and cut it from the tree. It proved to be *Hydnum septentrionale*, measuring about thirteen inches across, and weighing twelve pounds. The fungus was composed of layers, one above the other, alternately in light and dark brown shades of soft tints, growing darker at the base.

Where the fungus touched the tree, each layer seemed to spring directly from the wood of the tree; while each was connected with the one below it by processes resembling teeth or strings. The whole mass was compact and solid, yet there was a juiciness about the surface which made it necessary to handle it carefully lest the delicate surface become scratched. I have seen many similar specimens but rarely one so large and perfect. I noticed a statement in the NATURALIST that, as a rule, the large fungi of this species are not far from the ground. But I think that in Maine, at least, they grow high on the trees. I have many times seen them too high to reach, and I incline to the belief that a greater altitude is the rule and not the exception.

On the same tree where I found this large fungus there were several small ones lower on the trunk.—*C. W. L. Rich, Auburn, Maine.*

NEW FLORIDA FUNGI. II.—*Asterina intricata* E. & M.—Perithecia (½–¾ mm diam.) suborbicular, flat, black, of a reticulated structure, the free ends of the reticulation forming a short, subhyaline, marginal fringe; asci abundant, obovate, sessile, 15×10μ.; sporidia narrow, clavate-oblong, hyaline, with a faint gelatinous border, about 9 × 3μ., endochrome once divided. Remarkable for its large flat perithecia scattered over the lower surface of the leaf without any very distinct mycelium. On living leaves of *Quercus arenaria.*

Venturia cupulata E. & M.—Perithecia hypophyllous, scattered, astomous, 300μ. diam., hairy around the base, bald and collapsed above; hairs setaceous brown black, apices entire, 210 × 6μ.; asci oblong, 48 × 12μ., eight-spored; sporidia obovate, hyaline, biseriate, uniseptate, 12–13 × 4–4½μ. On living leaves of *Quercus laurifolia.*

Venturia applanata E. & M.—Perithecia hypophyllous, lentiform (100μ.), perforated in the center, of subradiate cellulose structure, with a few (12–15) erect, brown, sparingly septate hairs, 70–100μ. long; asci oblong, 40 × 10–12μ.; sporidia in 2–3 series, ovate-oblong, 1-septate, yellowish, 10–12 × 3μ. On living leaves of *Magnolia glauca.*

Venturia saccardioides E. & M.—Perithecia hypophyllous, scattered, brownish-black, collapsing above (150–200μ.), clothed with bristle-like hairs 100–140μ. long; asci obovate, 4–6 spored; sporidia obovate, triseptate, constricted at the middle septum, hyaline, 15–16 × 3–3½μ. Probably the perfectly developed asci will be found to be 8-spored. On living leaves of *Magnolia glauca.*

Linospora ferruginea E. & M.—Spots light yellowish-brown, border darker, narrow and slightly raised, 1½–2 mm diam.; perithecia black, subglobose (150μ.), immersed and covered above by the blackened cuticle, perforated above but ostiolum scarcely prominent; asci cylindrical, 75–80 × 7μ, sessile or nearly so;

paraphyses abundant linear; sporidia 8, vermiform, yellowish, faintly nucleate, acute at each end, 35–45 × 1½μ. The perithecia are solitary, one in the center of each spot, but the spots are often sterile. On leaves of *Andromeda ferruginea.*

Phyllosticta terminalis E. & M.—Occupying mostly the dead, whitened tips of the leaves or occasionally the lateral margin, and bounded by a narrow purplish-black line. Perithecia globose, buried in the parenchyma of the leaf, the epidermis being slightly raised and blackened over them; spores oblong, 3–4 × about 1μ., on stout cylindrical basidia much longer than the spores themselves. On leaves of *Ilex dahoon.*

Septoria serpentaria E. & M.—Spots chestnut-brown, becoming darker, eroded, border obsolete, 1^{mm} diam.; perithecia black, subglobose, innate-epiphyllous, 156 × 140μ.; spores subhyaline, cylindrical curved, 82–108 × 4μ. On leaves of *Quercus laurifolia.*

Pestalozzia myricæ E. & M.—Spots irregular, chestnut-brown (5–10^{mm}), acervuli innate-erumpent, epiphyllous, 75μ. diam; spores oval, dark brown, biseptate, ends hyaline, 9–12μ. long, crest 2-parted; pedicels 12 × 2μ., contracted below. On living leaves of *Myrica cerifera.*

Helminthosporium fumosum E. & M.—Hypophyllous in loose, olivaceous tufts which form a circular group ½–1^{cm} diam, standing on a prostrate pale brick-colored, branching mycelium, which forms a radiate-fimbriate margin around the whole; the erect hyphæ are pale brown, simple, septate, 75–80 × 6μ., and bear at their tips a single obovate, brown, 3-septate spore, 25–30 × 10–12μ. On living leaves of *Persea palustris.—J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Gray's Contributions to North American Botany.—From Vol. xix of the Proc. Am. Acad. of Arts and Sciences, we have received a thick pamphlet of nearly one hundred pages of Contributions to N. A. Botany, by Dr. Asa Gray. The greater part is taken up with characters of new Compositæ, with revisions of certain genera, and critical notes, while the remaining portion includes miscellaneous genera and species. It is impossible to over estimate the value these occasional contributions possess for the careful student of systematic botany. The critical notes upon species are especially instructive, and might well be studied with care by our younger botanists who are entering upon work in the field of systematic botany.

Among the interesting plants described is a white-rayed Silphium (*S. albiflorum*) from Texas, closely related to the ordinary compass plant. In the thistles (now of the genus Cnicus, formerly Cirsium) the species *C. discolor* is hereafter to be the variety *discolor* under *C. altissimus.*

"Of genuine Lactuca, or the Scariola section, we appear to

have five indigenous species, namely, *L. canadensis* L., the oldest name of the *L. elongata* Muhl., &c.; *L. integrifolia* Bigelow (a better and perhaps as old a name as *L. sagittifolia* Ell., which is not quite certain); *L. hirsuta* Muhl. and Nutt. (as old and quite as good a name as *L. sanguinea* Bigelow); *L. graminifolia*, a southern species of wide extension westward; *L. ludoviciana* DC., a species which ranges from Dakota to Texas, and is marked by its larger heads and more imbricated and large-bracted involucre."

A new species of honeysuckle (*Lonicera sullivantii*) is described. It occurs from Central Ohio to Illinois, Wisconsin and Winnipeg, and also in Tennessee, etc. It has hitherto been considered a form or variety of *L. flava*, from which it is now for the first time separated. If we understand it aright, *L. sullivantii* is the northern species, while *L. flava* is strictly a southern species. In this connection it may also be stated that hereafter the small honeysuckle (*Lonicera parviflora* of the manuals) is to be known as *L. glauca* Hill, and that the var. *douglasii* is to be erased.

A Suggestion in regard to the Publication of new Species.—Some months ago one of the foremost of our American botanists suggested the propriety of demanding in case of publication of descriptions of new species in scientific journals, that specimens should in every case accompany the descriptions. The suggestion is well worth considering in these days when nearly every discoverer is inclined to make free use of his right to describe what he has found. There can be little doubt that it is wise to permit and encourage such work on the part of our best collectors. The stimulation it gives to the whole work in the field of systematic botany is no small part of the good which results. But a serious inconvenience often arises as a consequence of such a mode of publication. It is, in the first place, difficult to find the descriptions on account of the well-known inaccuracy of most of the journal indexes, and in the second place it too often happens that the specimens upon which the descriptions were based, soon become inaccessible. These difficulties might be more or less completely remedied by our scientific journals adopting any of the following plans:

1. Every description to be accompanied by the statement that type specimens were deposited in this or that established herbarium.

2. Every description to be accompanied by specimens to be distributed by the editor of the journal giving such publication.

3. No description to be given until specimens are deposited in the National Herbarium.

The last is essentially the recommendation made in the November number of the London *Journal of Botany*. It would simplify matters very much if in every case the deposited speci-

mens were soon accompanied by the printed descriptions. We shall return to this matter again ere long, and in the meantime shall be glad to receive further suggestions.—*C. E. Bessey.*

Remarkable Fungus Growth.—I have lately received from Messrs. B. M. Everhart and W. T. Haines, of West Chester, Pa., a very curious growth, an account of which may be of interest. This strange production is no doubt an abortive growth of the mycelium of some fungus unable to assume its normal form and character for want of light and air.

In the letter of Messrs. Everhart and Haines, accompanying the specimen, they say: "About two years ago a gentleman of this place, Dr. Warren, preparing to build a stable on his place, visited Philadelphia and purchased some of the material taken from the buildings then being torn down to make room for the new depot of the Penna. R. R., at Fifteenth and Filbert streets. This material consisted of pine flooring and hemlock joists, and was used by Dr. Warren for laying a floor in the stable he was building. Under this floor was a cellar about four feet deep without window or opening of any sort, and consequently entirely dark. Some time afterwards, for the purpose of ventilation, a hole or trap door was cut through this floor, when it was discovered that the under side of the floor was coated and festooned with the curious fungoid growth before mentioned. Here and there were hollow, bladder-like bodies six inches in diameter and perhaps twice as long, suspended by a stringy mycelium, while in other places a sponge-like mass of mycelium a foot in diameter would be suspended like the bladder-shaped bodies by a cord or string of mycelium as thick as one's finger, the lower part of the suspended mass reaching nearly or quite to the bottom of the cellar and hanging in loose shreds like pieces of white cloth that had been through a threshing machine. The texture of the whole was very light and delicate, so that the cotton-like fibers of the outside of the suspended bodies would move with the least breath of air. The whole was very moist, with drops of water standing on it, and seemed to be enveloped in a mist. Portions of this curious growth taken out and hung in a dry room near a hot stove had, in two days, shriveled to less than half their original size, and were of a yellowish-white color, had a rather agreeable sweetish smell and adhered slightly to the fingers. On shaking the dried mass fragments like snow flakes separated and fell to the floor."

The specimens sent me some days ago have not changed in appearance since I received them. One of them consists of a spongy, white, torn and ragged bundle like a much-worn dish cloth or bundle of white rags, more compact above, where it is gradually contracted into the suspending cord, which is about as thick as one's finger, tapering above to the size of a pipe stem and

of about the same consistency and appearance as a piece of deer skin.

My friends, Messrs. Everhart and Haines, incline to the opinion that this is the *Byssus septicus* of Withering, and quote descriptions of that production which is said to "grow most luxuriantly in bins or on wooden shelves in cellars where wine has been spilt, hanging down in the form of a jelly bag or of a cylinder with a globe at the end, to the length of a foot or more. It is easily crushed, and then seems principally to consist of water adhering to the fingers." It is quite probable that this may be the genuine *Byssus septicus*, but it is evidently only the mycelium of some fungus, being entirely without fruit of any kind, and of the same nature as the curious fungoid growths in old abandoned mines and subterranean galleries. To what species this mycelium pertains it is of course impossible to say, though it is not improbably the mycelium of *Polyporus destructor* Fr., which in confined and damp places is known to luxuriate in various abnormal growths.—*J. B. Ellis, Newfield, N. J.*

ERRATUM.—By an annoying typographical error on page 1280 of the December NATURALIST, ninth line from the bottom, the word *Entomophthora* was misspelled.

BOTANICAL NOTES.—Dr. Farlow, in the November *Botanical Gazette*, concludes his interesting and valuable "Enumeration of the Peronosporeæ of the United States." It is in reality much more than an enumeration, for every species (thirty-six in all) is described, and for each the synonymy is given, as well as reference to the exsiccati and literature. The species are distributed as follows: Phytophthora, 1; Peronospora, 31; Cystopus, 4.——The publishers of the *Botanical Gazette* offer a prize of fifty dollars for *the best life-history of any plant*, the result of original investigations. The papers are to be finished on or before the 1st of Nov., 1884. Further particulars may be learned by addressing the editor of the *Gazette*, Crawfordsville, Indiana.——A similar prize of from sixty to one hundred dollars for the best paper, and of fifty dollars for the second best, is also offered by the Boston Society of Natural History, as announced in the advertising pages of the NATURALIST. Surely biological botany should no longer lag.——Dr. Vasey's "Grasses of the United States," recently issued as a special report from the Department of Agriculture, Washington, D.C., is one of the most valuable papers which that department has issued. Synopses and descriptions of the tribes and genera of our native grasses are given, and under each genus all our indigenous species are catalogued. The arrangement is in accordance with that of Bentham and Hooker in their Genera Plantarum. The whole number of genera is 114, while of species there are enumerated 589.——The Catalogue of Canadian Plants, Part 1, Polypetalæ, by Professor John Macoun, which has lately appeared as

one of the publications of the Geological and Natural History Survey of Canada, is a publication of much promise. It is doubtless the forerunner of a flora of Canada, which has long been needed. It includes 907 species, although extending no further than the end of the Polypetalæ.——The Catalogue of the Plants of Worcester county, Mass., by Professor Joseph Jackson, published by the Worcester Natural History Society, is creditable both to the author and the society which furnished the means for its publication. It contains 812 species and well-marked varieties, distributed among 387 genera. Why do not more local societies undertake the publication of such lists?——From the Bulletins of the U. S. Fish Commission we have a list of marsh and aquatic plants of the U. S., many of which are suitable for carp ponds, by L. F. Ward. It includes flowering plants only.

ENTOMOLOGY.[1]

THE GENUS COLIAS.—As "Contributions from the Northern Transcontinental Survey," Dr. H. A. Hagen has sent us from the Proceedings of the Boston Society of Natural History, Vol. XXII, pp. 150–178, an interesting paper containing the results of his studies on the genus Colias. We have read it over with a good deal of interest and care, and while it upsets much of the descriptive work which Mr. W. H. Edwards has done, we feel that Dr. Hagen is in almost every case justified by the facts and by the recognized variability in the genus and in Lepidoptera generally. Dr. Hagen's method has been, first, to familiarize himself with the publications on the subject both here and abroad, and then to critically study large sets of specimens wherever such were available. He reduces the number of species (exclusive of *eurydice* and *cæsonia*) to nine, as follows:

1. *Colias chrysotheme* = *keewaydin*, with seasonal forms *ariadne* and *eurytheme*.
2. *C. philodice*, with seasonal form mimicking *ariadne*, and with north-western forms *eriphyle* and *chrysomelas*.

   ("Nos. 1 and 2 are so nearly related to each other that obviously reliable differences are still a want," p. 152.)

3. *C. interior*, synonyms *edwardsii* with *emilia* and *astræa*, *alexandra*, *scudderi*, *occidentalis*, *christina*, var. *harfordii* with female *barbara*, var. *laurentina*. (*C. pelidne* Boisd., is united with *C. palæno*, unless the type should prove its identity with *C. interior*.)
4. *C. palæno* with var. *pelidne* Boisd., Staud, and *chippewa*.
5. *C. meadii*.
6. *C. behrii*.
7. *C. nastes*.
8. *C. hecla*.
9. *C. boothii*.

Nos. 5 to 9 are simply enumerated, as little or no material was

[1] This department is edited by PROF. C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc., should be sent.

at hand, and it is safe to assume that species founded as they have been, on limited material, will not stand, but will all come to be looked upon as extreme forms of *chrysotheme*. However this may be, but four species that are at all well known, exclusive of *eurydice* and *cæsonia*, are recognized by Dr. Hagen.

A critical study of his paper renders it doubtful whether the context warrants even these four. *C. harfordii* and *barbara* are made (on p. 165) synonymous with what Wm. H. Edwards figured as the male of *keewaydin*, so that *interior*, of which they are also made synonyms, should perhaps be joined to *chrysotheme*. *Philodice* and *anthyale* are made synonymous, while Mr. W. H. Edwards also acknowledges in his later writings the identity of *palæno* and *anthyale* with *philodice*, and of *ariadne* and *keewaydin* with *eurytheme*. Thus the logic of Dr. Hagen's showing is, that of the common and wide-spread forms we have but two species viz., *chrysotheme* and *philodice*. The fact that Moeschler and Keferstein unite *interior* with *philodice* also confirms the invalidity of *interior* and of all the varieties that Hagen associates with it.

Now we have long held the opinion that *eurytheme* and *philodice*, as they occur in the Mississippi valley, could not satisfactorily be separated by any permanent specific characters, and our breeding experience tends to confirm this view (though the notes have never been published). Hence as Hagen argues that *eurytheme* and *chrysotheme* are one, by parity of reasoning the conclusion is inevitable that our commoner North American forms of Colias are all reducible to three, viz., *eurydice*, *cæsonia* and *chrysotheme* with its thirty or more races and varieties. This would seem to mean that the more fully abundant material from all sections is studied, the more hopelessly confused our specific divisions become, and this is just what it does mean, as we insisted in our recent remarks (p. 975) on the discussion of a similar question between Messrs. Hagen and Edwards. Some years ago in private correspondence with the latter, we insisted that half the so-called species, including some of his own, ought to be rejected, and that we recognized but two good species at St. Louis, viz., *cæsonia* and *eurytheme*, not being satisfied at that time that this last was identical with *chrysotheme*. Some of the species have been made on ridiculously trivial grounds, while others deserve the designation according to the ordinary conceptions of specific value among lepidopterists. A study of the genitalia may serve to separate two or three of the well-founded species and the rest should fall in as ordinary varieties, geographical varieties and races, and seasonal forms, the names proposed as specific being retained for convenience, very much as Mr. Edwards has so admirably done with the forms of *Pieris napi*.

The genus may be looked upon as a plastic one in which the species are in process of forming, but in most cases have not be-

come well differentiated. The pamphlet quotes in a postscript the characters which Mr. Keferstein has found variable and therefore not of specific value in the genus. These include the discal spots on upper side of primaries and under side of secondaries, the submarginal series of spots on under side of primaries and the "mealy spot." If we add coloration within limits, and form of wing, as we are justified in doing, we must evidently depend on the more constant though less noticeable structure of the body. —*C. V. R.*

Habits of Blaps and Embaphion.—Among the more recent introductions from the Old World are two species of the Tenebrionid genus Blaps.[1] Both species occur in Europe abundantly in stables, warehouses, dirty cellars, etc., and are so rarely met with away from such buildings that they may properly be included among the numerous "domestic" insects to which the family Tenebrionidæ furnishes a not inconsiderable contingent. The North American representatives of Blaps are the numerous species of Eleodes which form the most conspicuous feature of the Coleopterous fauna of the Central and Pacific regions of our continent. Some of the species occur in an incredible number of individuals but I am not aware that any species has thus far any tendency to acquire habits similar to those of the two Blaps mentioned above. Mr. Lawrence Bruner informs me, however, that another large Tenebrionid, *Embaphion muricatum* Say, is at present met with in large numbers in cellars in Nebraska, and that it is much more frequent in such places than outdoors. It would thus appear that this Embaphion flourishes more in the vicinity of human habitations than in its native haunts, and this fact is the more interesting that the species belongs to the small number of native American species which are habitually met with in our houses, the large majority of such domestic Coleoptera being either European forms or at least cosmopolitan species of uncertain origin.—*E. A. Schwarz, Washington, D. C.*

Larval Habits of the Dipterous family Dexidæ.—Dr. Fr. Brauer has recently made some interesting observations on the entomography of *Hirmoneura obscura* (Sitzungsber. d. Kais. Akad. d. Wiss. LXXXVIII, pp. 865–75) which have incidentally led to the discovery of two other Dipterous parasites of the Rhizotrogus larva and belonging to the family Dexidæ, of which little has thus far been known. A small parasitic larva produced *Dexia rustica* Fall., while another larger one was found within the abdomen of the Rhizotrogus larva adjacent to the colon of the intestinal canal. It was encased in a membraneous sac closely resembling the colon and which, tapering posteriorly, ended in a some-

[1]The specimens I saw and which were said to be found in Virginia were all *Blaps fatidica*. Of the second species, *B. mortisaga*, I have not yet seen undoubted American specimens.

what bent, chitinous funnel, open at the end. This opening probably connects with one of the tracheæ of the beetle larva. The Dipterous larva lies in this sac with its abdomen reaching within the funnel. Puparia of the parasite were found in the ground and produced in July the perfect fly, which proved to be *Phorostoma latum* Egger. Dr. Brauer describes and illustrates the anatomical details of this larva.

Of our North American Dexidæ the habits of only one species have been recorded thus far, viz., the parasite on *Diabrotica vittata*, described by Dr. Henry Shimer (Am. Nat., v, p. 219) as *Melanosphora diabroticæ*, a species which is doubtfully referred in Osten-Sacken's catalogue to the genus Melanophora Meigen, as the figure and description do not permit of positive determination.

Northern Localities for Southern Butterflies.—In the November number of the Naturalist, Mr. Smith, of Natick, Mass., reports Mr. Scudder as saying that the most northern locality in which *Junonia cœnia* has been found is the southern extremity of Maine, near Portsmouth, N. H. One example of this species was captured last summer by a gentleman from Bangor, in woods about four miles south of Orono. It was as large and nice as the average of a large lot captured in Florida. *Chionobas jutta* has also been taken for several years in a bog in the same vicinity. I think this is the first time it has been reported within the limits of the United States.—*Mrs. C. H. Fernald, Orono, Me.*

Insect-life among Spider Eggs.—At the annual meeting of the San Diego, Cal., Natural History Society, a letter from Miss Rosa Smith was read referring to the discovery of the mature male of *Zilla rosa*, a beautifully colored California spider, and the insect life observed in the egg cocoons of *Epeira atrata*, the species having been determined by Dr. H. McCook, of Philadelphia. They are (1) a small ant, probably referable to Solenopsis and doubtless feeding on the spider eggs; (2) larvæ of a Dermestid beetle (*Attagenus pellio ?*), apparently feeding on the refuse matter in the nest; (3) a true parasite of the Epeira eggs belonging to Pezomachus, having a secondary parasite in an undetermined Chalcid fly, which in its turn proved to be infested by a still smaller species of the same family.

Aletia xylina in the North.—Yesterday in my little garden I took a wonderfully fresh example of *Aletia argillacea*, and two years ago, when in Toronto, I found the insect extremely common on fences, &c., in the streets of the city. I found one specimen on the wall of a garden, with its wings still damp and undeveloped, having just emerged from the chrysalis. I looked all round the garden but found no Malvaceous plants except a large bush of Abutilon and the little wild mallow, *Malva rotundifolia*. —*Hy. Edwards, New York, Oct. 23, 1883.*

AQUATIC SPIDERS.—Waiting beside a mill-pond on a mild, balmy day last March, a slight wind prevailing but not enough to ruffle the surface of the water, I noticed a spider let himself down into the water from one of the trees bordering upon the pond, and as soon as it reached the water the web or strand was severed with such a length attached to his person as to act as a sail and serve to assist his propulsion, with the favoring breeze, to the other side.

Numerous spiders followed the same procedure with webs of varying lengths from three to eight feet. I supposed this was their method of crossing from side to side in search of more abundant food.

I may perhaps be only repeating what was before well-known, but as it was new to me I give it for what it is worth.—*George C. Henning, Washington, D. C., Nov. 17th, 1883.*

THE PHYLLOXERA IN SANDY SOIL.—The London *Times*, in a recent issue, contains a dispatch which gives the condition of the French grape crop, as follows:

"Only twelve of the southern departments seem satisfied with their vintage. The yield in general is expected to be even below the average of late years. Burgundy and Champagne report a yield extremely deficient, both in quantity and quality; while Macon counts upon a better crop than had been predicted, though of somewhat poor quality. In Charente the quality is also poor."

The same dispatch, in summing up the observations of Lalande, mayor of Bordeaux, on the conditions of the vines in the Phylloxera-infested sections of the country, gives a most favorable account of the use of American stocks, and shows that even the French vines at Aigues-Mortes are flourishing in the sandy soils, thus emphasizing the fact of the impotence of the Phylloxera in such sandy soils.

OSAGE ORANGE VS. MULBERRY FOR THE SILKWORM.—There is a strong disposition on the part of those who look for making money by the propagation and sale of mulberry trees, to underrate the use of osage orange as silkworm food. We have thoroughly demonstrated, by the most careful tests, on several occasions, that when *Maclura aurantiaca* is properly used for this purpose, the resulting silk loses nothing in quantity or quality, and we have now a strain of *Sericaria mori* that has been fed upon the plant for twelve consecutive years without deterioration. There has been, perhaps, a slight loss of color which, if anything, must be looked upon as an advantage. It is more than likely, however, that the different races will differ in their adaptability to the Maclura, and that for the first year the sudden transition to Maclura from Morus, upon which the worms have been fed for centuries, may result in some depreciation. Mr. Virion des Lau-

riers, at the silk farm at Genito, has completed some experiments on the relative value of the two plants, which he details in the opening number of the *Silk-Grower's Guide and Manufacturer's Gazette.* Four varieties of worms were reared. The race known as the "Var" was fed throughout on mulberry leaves. The "Pyrenean" and "Cevennes" worms were fed throughout on leaves and branches of osage orange, while the "Milanese" worms were fed on Maclura up to the second molt and then changed to mulberry leaves. At the close examples of each variety of cocoons were sent to the secretary of the Silk Board at Lyons, and appraised by him. The Maclura-fed cocoons were rated at 85 c. per pound, those raised partly on osage and partly on mulberry at 95 c. per pound, and those fed entirely on mulberry at $1.11 per pound.

This, Mr. des Lauriers thinks, seems to show that the difference between Maclura and Morus as silkworm food is some "twenty-five to thirty per cent in favor of the latter, while it is evident that the leaf of the osage orange can be used with some advantage during the *first two* ages of the worms, thus allowing the mulberry tree to grow more leafy for feeding during the last three ages." The experiment, although interesting, is not conclusive, from the simple fact that different races were used in the different tests and not the same races, so that the result may have been due, to a certain extent, to race and not to food.

THE CHINCH-BUG IN NEW YORK STATE.—Professor J. A. Lintner, State entomologist of New York, has been interviewed at length in the Albany *Argus* of Oct. 10th on the subject of Chinch-bug injuries in Northern New York. It appears that its destructive work was first discovered in June, 1882, by Mr. H. C. King, of Hammond, St. Lawrence county, and that the destruction has increased the present year though confined to grasses.

In this interview, in a communication to *Science* of Oct. 19th, and in a circular issued from the office of the State entomologist, Oct. 18th, Mr. Lintner draws attention to the rarity of the chinch-bug in the State of New York heretofore; to its persistent injury in St. Lawrence county notwithstanding the past wet season, and finds in these facts reason for the greatest alarm on the supposition that this manifestation is due to an invasion, and that the insect shows exceptional power of withstanding constant rains, which are well known to prove disastrous to it in the Mississippi valley.

We have not been able to read over these accounts without feeling that an undue amount of alarm is felt. Since the chinch-bug was known to occur in New York at the time of Harris and Fitch, and is found further north both on the Atlantic seaboard and in the Northwest, we see no reason for considering that St.

Lawrence county has been invaded from other parts, but should rather attribute the recent injury to undue increase of a species always there, albeit not generally noticed and heretofore unrecorded. This increase may in fact be due to the excessively dry weather that characterized 1880 and 1881 and previous years, the reacting wet weather not having yet produced an injurious effect upon it. In this view of the matter, which seems to be most reasonable, the outlook is rather encouraging than alarming, and we fully expect to see this view corroborated by subsequent events, *i. e.*, the pest will sink back to its state of harmlessness next year and probably perish in immense numbers during the coming winter. We would not, however, by any means have the farmers relent from the measures recommended by Mr. Lintner in the circular already alluded to, though he can scarcely expect them to carry out his advice without some obligatory law or some compensation from the State.—*C. V. R., in Scientific American.*

Bacterial Disease of the imported Cabbage-worm.—Professor S. A. Forbes, State entomologist of Illinois, has found the larvæ of *Pieris rapæ* seriously affected, around Normal, Ills., by a disease which in a few hours causes them to decay and reduces them to a black almost fluid condition, dissolving at the touch. He finds the disease due to immense numbers of Bacteria, excessively minute, and that they can be cultivated artificially in beef broth and thus introduced and propagated among healthy insects.

This black rot of the cabbage worm has been known to us for some years and is quite widespread. We have made reference to it on page 70 of our Bulletin on the Cotton-worm in connection with some experiments with yeast ferment, in the following words: "An incident connected with these experiments which I made is, however, well worthy of being mentioned, because it shows how very easily single experiments may lead to false hopes and conclusions. A certain proportion of the last named larvæ [*P. rapæ*]—the proportion differing in the lots treated—perished before, or while transforming to the chrysalis state. They became flaccid and discolored, and after death were little more than a bag of black putrescent liquid. I should have at once concluded that the yeast remedy was a success had I not experienced the very same kind of mortality in previous rearing of this larva, and had I not upon returning to the field from which the larvæ in question were obtained, found a large proportion similarly dying there."—*C. V. R., in Scientific American.*

Entomological Notes.—In a notice of the papers by Mr. E. Meyrick on the Micro-lepidoptera of Australia, New Zealand and Tasmania, Professor C. H. Fernald states that *Carpocapsa pomonella* has been introduced to those regions along with the apple.

——Lord Walsingham writes us: "Noticing your mention of *Helia americalis* as a myrmicophilous Lepidopteron (Am. Nat., Oct., 1883, p. 1070), I would remind you of *Myrmicocela ochraceella* Tgstr., which is found also in ants' nests. It is allied to the true Tineæ.

ZOÖLOGY.

Owen on the Aspects of the Body in Vertebrates and Invertebrates.[1]—The pineal and pituitary bodies, with the infundibulum, constituting what our author styles the conario-hypophysial tract, have been the theme of much discussion among naturalists. Some have seen in the pituitary, a gland secreting the intraventricular fluids of the brain, while others have believed it to be a remnant of an obsolete sense-organ.

To Professor Owen it is neither of these, but is the residuum of the deutostome, or invertebrate mouth, opening on the neural aspect of the animal and superseded in the vertebrates by a "tritostome" or hæmal mouth. In proof of this view he shows that in the lower mammals the pineal and pituitary bodies and their connections are larger and have a less parenchymatous and more tubular structure than in man; that in reptiles the pineal production perforates, as a rule, the parietal bone, but in some cases the suture between parietal and frontal; and that in fishes the relative magnitude and tubular character of this transcerebral tract are still more marked. In the skate the extension of the pineal part reaches beyond the cartilaginous roof of the brain-case, and in all Elasmobranchs it is an elongate tube, dilated at its peripheral end and maintaining its communication with the third ventricle, from the floor of which the infundibulum extends to join the pituitary body. In the brain of the Chimæra the cerebral masses are separated from the optic lobes by cord-like lamellæ equal in length to the structures they separate. These cord-like lamellæ seem to represent the crura cerebri, and the space between them, which is traversed by the pineal body and its connections, is the third ventricle. This structure seems to indicate that the crura cerebri are homologous with the parial cords which girt the gullet and connect the fore brain with the hinder masses in invertebrates. In the embryos of all vertebrates the pineal extension seems in quest of an open or oral outlet, but is checked by the external skin in lower forms, and by the cranial roof of the brain in the higher ones.

If it be admitted, with the great authority who, following in the line of Geoffrey St. Hilaire, advocates the "Unity of Organization" of the vertebrate and invertebrate kingdoms, that just as the umbilicus is the remnant of the protostome or primordial mouth, so the pineal body and its connections are the remnant in

[1] Aspects of the Body in Vertebrates and Invertebrates. By Richard Owen. London, 1883.

the vertebrate of the neurally situated mouth of the arthropod or mollusk, then the objections urged by Cuvier against the views of his great rival are answered, and the dorsal (hæmal) aspect of a caterpillar or crustacean must be considered to correspond with the ventral (hæmal) aspect of a vertebrate. Hæmal and neural must then be used in preference to dorsal and ventral, since the latter depend only upon the position of the mouth, neural in the Invertebrata, and separating the brain-ganglia to become so; and hæmal in the Vertebrata by the abortion of the portion directed neurad, and the connection of the alimentary canal with the invagination of the ectoblast.

The arguments in favor of the homology of the dorsal aspect of an insect with the ventral aspect of a vertebrate are certainly far stronger than anything which can be urged against them, yet there seems to be at least one important point in which the conario-hypophysial tract fails to correspond with the invertebrate gullet. The whole of the tract in question is situated anteriorly to the optic vesicle in the embryo and to the optic lobes in the adult. The homologue of optic lobes and nerves should, therefore, if this tract represents the invertebrate gullet, be found in the sub or neur-œsophageal ganglion of the invertebrate.

That this is not the case is clearly shown both by the diagrams and descriptions of Professor Owen. The supra-œsophageal or hæm-œsophageal mass, in both cephalopod and insect, contains the optic nerves and the brain-enlargement at their base. If, as our author asserts, in agreement with other anatomists, the eyes of the cuttlefish are the homologues of those of the lumpfish, must we not seek for traces of the invertebrate deutostome between the optic lobes and the hind brain, rather than between them and the cerebrum?—*W. N. L.*

Forbes' Studies of the Food of Animals.[1]—Some of the results arrived at by this investigation have already been reviewed in the Naturalist. The first essay deals with the regulative action of birds upon insect oscillations, the second with the food relations of the Carabidæ and Coccinellidæ, the third with the food of the smaller fresh-water fishes, and the fourth treats of the first food of the common whitefish. The first brings out most clearly the fact that all passerine birds, even the seed-eating species, may be depended upon as aids against the canker-worm, and *presumably* against any other inordinately abundant insect, while the second shows that the Carabidæ are to a great extent vegetable feeders, the genera Harpalus and Anisodactylus especially; while the Coccinellidæ feed upon the spores of fungi, pollen-grains and plant-lice.

The so-called pirate perch (Aphredoderus), proved to feed

[1] Illinois State Laboratory of Natural History. Bulletin No. 6. Studies of the Food of Birds, Insects and Fishes. By S. A. Forbes.

almost entirely upon insects; sticklebacks eat about as much vegetable as animal substance; the small-mouthed atherinid *Labidesthes sicculus* is a purely animal feeder, dividing itself almost equally between insects and entomostracans; Fundulus and Zygonectes take but little vegetable food; the Cyprinidæ, with a long intestine and pharyngeal teeth with a broad grinding surface, feed principally upon vegetable food, ingesting much mud therewith; and in the Cyprinidæ, with hooked pharyngeal teeth and a short intestine, three-fourths of the food is animal. The smallest entomostracans form the first food of the young whitefish.

Exact observations of this nature are scarce, and of great value, and Mr. Forbes has begun a needed work.

SYMBIOSIS IN THE ANIMAL KINGDOM.—Professor Hertwig, according to *Nature*, at the last meeting of German naturalists, read a paper on this subject. This term, symbiosis, first suggested by De Bary in connection with certain phenomena of the vegetable world, is here extended to the whole organic system. As distinguished from ordinary parasitism, it is explained to mean the normal fellowship or association of dissimilar organisms which dwell together in a common abode for their mutual welfare. In the case of parasites the connection is altogether one-sided, one of the two organisms attaching itself to the other, and flourishing at its expense, as, for instance, the mistletoe on the apple tree. But in this newly-revealed phenomenon of symbiosis, which appears to pervade the whole biological world, both associates are mutually beneficial, and in some instances even indispensable to each other. They act, so to say, like two partners in a well-regulated business concern, coöperating in the work of life, taking part in all its toils and troubles, and honorably sharing the common profits. An illustration is drawn from the familiar hermit crab, one species of which, after taking possession of the first available empty shell, goes into partnership with a sea anemone (*Adamsia palliata*). This lonely creature, bright orange spotted with red, attaches itself to the roof of the common abode in such a position that its mouth and prehensile apparatus are always turned toward the head of its associate. It is thus enabled to join in all the expeditions of the restless hermit crab, and conveniently share in the common plunder. In return for this service, the anemone protects his companion from his many enemies by means of the numerous long threads which it shoots out at the least alarm, and which are provided with millions of capsules charged with a stinging acid like that of the common nettle. So close is the compact entered into by the two partners, that both have become indispensable to each other, as appears from a series of experiments made at the Neapolitan Aquarium. If the crab be removed from his house, and this be stopped up so as to prevent his reëntering it, he will cast about for another shell, and

never stop until his old associate is also transferred to their new abode. A still more remarkable illustration is drawn from the *imbauba*, or candle-nut tree of South America, which strikes up an alliance with a species of small black ant to their mutual benefit. The whole subject of symbiosis, which naturalists are only beginning to study, is calculated to throw great light on the Darwinian theory of biological evolution. The various cases of fellowship between animals and plants of different orders, and even between members of the animal and vegetable kingdoms, show how, in the perpetual struggle for existence, the individual organism avails itself of the smallest advantage to secure a place in the household of nature. It often thus acquires marvelous habits of life, which it is afterwards unable to lay aside, and in consequence of which it becomes gradually modified in its bodily form and organization. Thus *abyssus abyssum invoca*, one change superinduces another, altered conditions require fresh combinations, and the organic world resolves itself into an everlasting ebb and flow of life, in which the individual counts for nothing, the species—itself transitory—for but little, and the sum of existence alone is considered in the self-adjusting scheme of the universe. Symbiosis thus leads at once to a broader and more searching study of various branches of human knowledge. To prosecute the subject successfully vegetable and animal organisms must be examined, normal and morbid conditions attended to, anatomical and physiological questions investigated. For this boundless theme belongs to a border land in which zoölogy, botany, anatomy, physiology and pathology meet as on common ground.

Collecting and Preparing Infusoria.—Dr. H. Fol, in a fourth contribution to the knowledge of the family Tintinnodea, says that in the natural sciences, method plays a principal part; but it is nowhere of greater importance than in microscopical researches. Here the fitness of the investigator consists much less in any particular perspicuity than in the art of bringing into view the points that he wishes to know. Hence the employment of a new method has enabled him to see clearly many things which he had previously been unable to see, or which he had seen imperfectly and misunderstood. The collection of the Tintinnodea in the sea is an easy matter. There is no danger of damaging them at the moment of their capture, seeing that their test, into which they withdraw at the smallest sign of danger, sufficiently protects them. They are pretty robust and swim briskly about in the bottles several hours after their capture, and at a time when many delicate animals are already dead or disfigured. It is not, however, at the surface of the sea, or under a bright sun, that we find them in the greatest abundance. In cloudy weather they rise to the surface more readily than in bright weather, and in the daytime they are found chiefly at a depth of several fathoms. For

their capture he employed a net of fine muslin of a conical form, attached to a ring about 50^{cm} in diameter. The bottom of the net presents a contracted opening, like that of a "well," which opens at the middle of a much smaller net made of silken sieve-cloth, with very fine meshes. This latter is attached to a ring, equilibrated by a fragment of cork. This net of silken gauze does not injure the animals at all, and it captures at least twice as many as the glass bottle which some naturalists substitute for it. It is easy to understand, in fact, that the impermeable walls of the bottle compel the water to turn in its interior, and cause eddies, which carry out a considerable proportion of the captured animals.

With creatures so active and so difficult to observe alive under a high power, it is of great importance to have a process which enables them to be fixed instantaneously in their natural attitude before they have had time to withdraw into their test, and which preserves faithfully the details of their structure.

Dr. Fol tried the various reagents most in vogue without attaining his purpose. With weak osmic acid he did not succeed in preserving the cilia of the peristome; and with a stronger dose the body became absolutely opaque; in both cases there was always a strong contraction.

Acetic acid, chromic acid and picro-sulphuric acid only gave him a fixation which was too slow, so that the animal died contracted in the bottom of its test. Finally he "succeeded with a reagent which is not employed in histology, perchloride of iron;" by its means he has obtained a considerable number of specimens of various species, fixed in a state of full expansion. These subjects, washed with alcohol and treated with gallic acid, present a brown coloration which is especially localized upon the nuclei, and renders them very visible; the other parts of the animal acquire a light-brown tint, which renders them easy to see.—*Journ. Roy. Microscopical Society.*

How the Boring Sponge penetrates Limestone and Shells. —In an essay on the biology and anatomy of the boring sponge (Clione), by N. Nassonow, assistant in the Zoölogical Museum at Moscow, published in the *Zeitschrift für wissenschaftliche Zoölogie* for Nov. 6th, the author attempts to answer the question how the sponge forces its way into hard calcareous bodies, and how it accomplishes its work of destroying shells, corals, etc. His observations were made in May and June, 1881, at the biological station at Sewastopol. For a long time, he remarks, different species of this genus of sponges have been known to live in the shells of numerous mollusks, and in corals, while Oscar Schmidt has described two species living in limestone, and Hancock found on the coast of Northumberland almost every stone bored in all directions by different species of Clione. Finally,

Tscherniawsky commonly found in the Black sea very large stones which were perforated like a sieve by colonies of Clione; these worked in conjunction with numerous boring Nemertine worms, annelids and bivalves, so that the durability of stone piers, wharves and other marine structures was impaired.

The question then arises how the Clione bores its way into the hard calcareous structure. Does it go on in a chemical or mechanical way, or does the sponge simply settle itself in passages previously bored by other animals? We must, he says, consider *a priori* that the parasite sponges are supplied for this purpose with special means or facilities which are wanting in the free-living sponges. Hence arises the second question: How has the parasitic mode of life expressed itself in the structure of the body? Nassonow set himself to the task of answering these inquiries. To observe how they set at work, he bred the sponges from the egg, cultivating them on thin, transparent plates of lime, and in this way could observe the operations of the sponge by transmitted light.

On June 11th he noticed a number of embryo sponges which had attached themselves to the upper surface of these plates as minute, thin, yellowish, round spots. In this condition the young sponge begins its work of destruction. At first it appears as a rosette-like mark. The sponge sends out fine offshoots into the substance of the plate, following the lines which form the outline or lobes of the rosette. June 12th, the little sponge had sent its protoplasmic roots deeper and deeper into the plate, finally occupying the part of the plate which corresponded to the rosette. Toward evening the whole rosette-like spot had disappeared from the upper surface, and soon had formed a small circle of little pits, each pit corresponding to a single lobe of the rosette. The little sponge had compressed into the minute pits the greatest part of its body, but on the upper surface, near it, lay a heap of broken calcareous particles of ellipsoidal form, the under convex surface being cut by the rootlets of the body out of the substance of the shell or plate. In this way the sponge exercises a chemical[1] and mechanical destructive agency, with less expenditure of energy. Instead of dissolving each single particle of lime, it dissolves a thin calcareous layer which corresponds to the convex upper surface of the particle. That the work is cut down by aid of the spicules is proved by the fact that they do not exist at this early stage.

All the lobes (10–15) of the rosette become eaten out in one day. Hence it results that the destructive energy of a fully-grown sponge, with all its branches and galleries, occupying a very considerable surface, is naturally very great.

[1] The sponge bores its passages, in all probability, by secreting an acid. To detect the presence of the acid would be difficult on account of the strong alkaline reaction of the sea water.

The remainder of the paper is devoted to histological facts and an attempt to show the relations of the sponge structure to its parasitic mode of life.

Polymorphism and Parthenogenesis in Mites.—A. Berlese states that the adult Gamasus, like all parthenogenetic forms, produces viviparously hexapod nymphs, which never develop ova till they reach the mother-stage. Both the larvæ and the nymphs are distinguishable by their soft hyaline epidermis and the complete absence of any reproductive organs. There are nymphs which ought to become males, and others which should become females; and this, which is the most frequent arrangement, may be spoken of as the normal series. In addition there are individuals which cannot be produced by the adults or the higher forms of the series, but they are derived from two distinct groups, which, like the adults, are of the ordinary, or of the extraordinary series. Thus *G. tardus* produces a special larva from which, by rapid metamorphosis, there is developed a larger octopod nymph. During the whole of its development this form is octopod and asexual; it molts as it grows, but does not seriously alter in form; at the later molts a slight difference may be detected between the future males and females, but there are no traces of any secondary sexual characters.

A detailed account is given of the metamorphosis of *G. tardus*, *G. coleoptratorum*, *G. stabularis* and *Trachynotus inermis;* in the last of these pædogenesis is especially well marked.—*Journal of Roy. Micr. Soc., April.*

Water-collecting Apparatus for Mites.—Mr. C. F. George states that he has used the following in searching for Hydrachnidæ, and has found no other piece of apparatus so efficient: A piece of thick brass wire is bent at about six inches from one end into a ring four or five inches in diameter. After connecting with some finer wire the two extremities of the ring, bend the stout wire at right angles to the ring, and continue it for about four inches. Then make another ring about one and a half inches in diameter, and there terminate the wire, leaving the small ring, however, not quite complete. The two rings will thus be parallel to each other. On the upper ring stitch a piece of tape, and to this sew a piece of muslin, made in the shape of a conical bag, and having its wider end affixed to the tape. Into the lower opening of this bag a small, wide-mouthed glass bottle, of about two ounces capacity, should be fastened by a piece of thread or fine string, and the lower ring is then sprung around the neck of the bottle. The other end of the brass wire, which was left projecting for about six inches, is now to be firmly lashed to a light cane or stick, and the apparatus is complete. In order to use the apparatus, move it gently backwards and forwards on the surface of the water, under the surface, or just above the bottom of the

pond, and among the weeds; the muslin will allow the water to pass through it, whilst any living organisms will be retained by the bottle. This can from time to time be examined with a pocket lens, and when it is found to contain anything, the lower ring of wire can be slipped off and the neck of the bottle pushed up through the upper ring, inverting the net. The contents may then be poured off into another bottle, and after rearranging the apparatus, fishing may go on again. The object of the piece of wire connecting the two ends of the net is to keep all stiff, so that the bottle can be turned in any direction, and yet both the upper and lower mouth of the net will remain open.

Spawning of the Axolotl.—Last year Mr. E. G. Blackford received two specimens of the Mexican laxolot *(Amblystoma mexicanum)*, which had been bred in France. They were albinos, as is often the case, and attracted much attention from visitors to Fulton Market. Last March the female laid many eggs—perhaps a hundred and fifty—and a few were hatched. To the surprise of all she has just laid another batch, but it is too soon to say if these will produce young. Some of the eggs have been sent to Mr. J. A. Ryder, of the U. S. Fish Commission, who will study their embryology if they prove to be fertile. We do not think it is generally known that this batrachian spawns twice a year.—*Forest and Stream.*

Why Salamanders are not Eaten by Frogs.—About a year ago the writer captured a leopard frog in a meadow. It had not lost the direction of the water, for, on being pursued, it took long leaps toward the brook, which it could not see. It was brought home and a place prepared for it in a fern case. A vessel of water surrounded by moss and stones and growing ferns was covered by a large glass case. In this prison the frog passed the entire winter. He had for company two red salamanders and a younger brother of his own kind. The latter disappeared during the first day, eaten by the larger amphibian, and after him went every creeping and flying thing whose size would permit it to be swallowed, except the salamanders. It was amusing to see Rana undertake a meal of salamander meat. He tried it several times before he learned better. His little victim would almost disappear from view down the capacious gullet, but the pungent liquid thrown out from all parts of the body seemed too much for the frog's palate, and it was invariably ejected. After this trial of strength the three prisoners became great friends, and the salamanders would often crawl over the frog, he winking at their familiarity and rarely paying any attention to them.—*W. W. Theburn in Scientific American.*

Food of Snakes.—When out after prairie chickens in August last, I crossed a large ditch which was all dried up except some small pools in which were large numbers of the common bream

or sunfish, *Pomotis vulgaris*, about one inch in length. In one of these pools two of the common garter snakes, *Eutænia sirtalis*, were catching these little fishes. Happening to pass the same place the next day, I found the pools dried up and the fish all dead. I was much surprised to see one of these snakes hastily moving away with one of the dead fish in his mouth. Is it common for these snakes to feed upon fish? Is it not uncommon for any serpent to take as food an animal already dead?—*E. A. Gastman, Decatur, Illinois.*

California Long-billed Marsh Wren.—June 18, 1882, a friend and myself started for Soap lake, San Felipe, with the intention of getting a few sets of eggs of this bird. Arriving there we pulled on our long boots and plunged into the tules in different directions. After an hour's hard work we returned and reported—one set of badly incubated eggs. My friend's experience was about the same as mine. I had found and examined some twenty-five nests, and of that number only three had been lined and used; two had been deserted, the third had the above-mentioned set. The other nests were of the same appearance outwardly, being woven of coarse bark of tules, but without the soft wooly lining of fine shreds of cotton tule and ducks' feathers. Some looked new, others old, and were situated, mostly, just out of reach in the taller clumps of tules. I saw but few birds, and these were fearless, approaching within two feet and looking me in the eye. Now, what can be the object of all these extra nests? Do the other birds build them for a shelter, and in case they are disturbed can immediately occupy another nest, or like children who build mud houses for amusement, and because they have nothing else to do? I hope to make another trip to the place when I have more time, and to be in better season.—*A. D. Butterfield, San José, Cal., in Oölogist and Ornithologist.*

Zoölogical Notes.—*Infusoria.*—The parasites found in the oysters of Arcachon and La Rochelle are the subject of a communication of A. Certes to the French Zoölogical Society. Among these are the following Infusoria: *Hexamita inflata* Dujardin, *Trypanosoma balbiamii* Certes; a species of Enchelyodon which conjugates after developing actively by fissiparity, and after conjugation again becomes actively fissiparous, and *Prorocentrum micans* Ehrenberg.

Cœlenterates.—M. Mérejowsky has contributed to the Bulletin of the French Zoölogical Society an account of the development of Obelia. Before fecundation the eggs develop at the expense of the endodermic cells; the nucleolus takes the form of a chaplet bent upon itself, the grains of the chaplet separate and divide, and the ripe egg before fecundation does not present the least trace of a nucleolus in its entirely homogeneous nucleus. The blastula is composed of cells of very various sizes, its walls are

pierced by pores, and the endoderm is formed by the immigration, one by one, of the blastodermic cells, this immigration taking place only at the posterior part of the larva. In further development the ectoderm appears to be double, but this appearance is due to a differentiation in the protoplasm of the cells; and the gastric cavity appears first as a fissure in the center of the endodermic parenchyma. The perisarc of the hydroid form is very probably the product of the secretion of special unicellular glands, disposed in the ectoderm. The medusa does not necessarily die after it has laid its eggs. Under favorable conditions it lives, but changes in form, the umbrella relaxes, turns upwards, and ultimately forms a sac having a few tentacles around its narrow opening. Meanwhile the pendant manubrium loses its tentacles, and forms the base of the hydra-like animal, while the mouth narrows to a pore, by means of which the animal fixes itself. The cavities of the manubrium and of the larger sac formed from the reversed umbrella ultimately communicate, the ectodermic cells lining the latter each acquire a vibratile cilium and become endodermic, and the upper opening does duty for a mouth.——Dr. Otto Hamann (*Jen. Zeitschrift für wissenschaft.*, 1882) gives the results of his researches into the structure of the Hydrozoa. In the first chapter he treats of the various parts of these organisms; in the second of their polymorphism, the homologies between medusoid gonophores and medusæ, their embryology, the relationship between the hydroid polyps and the Siphonophora and Anthozoa, and their classification. He divides the entire class into the legions Hydropolypi and Coralpolypi, the first containing the orders Intæniolatæ, characterized by simple stomachs and polyps contained in capsules, and Tæniolatæ, with folded stomachs; and the second embracing the Milleporidæ and the Stylasteridæ. The numerous diverticula of an anthozoan are a complication of the foldings of the Tæniolata, and the anthozoan larva, with four septa, recalls the structure of the tæniolate Hydrozoa. In a second part Dr. Hamann goes more thoroughly into the histology and anatomy of some forms of Tæniolatæ and Intæniolatæ, and describes two new species (*Podocoryne haeckelii* and *Plumularia fragilis*). A third part is devoted to histiogenesis.——Another article by the same naturalist treats of the anatomy of the nettle capsules, etc., of Hydra. The researches were carried on at Heligoland and at the Naples Zoölogical Station.——Mr. R. E. C. Stearns describes a new Pennatulid from Japan under the name of *Radicipes pleurocristatus* (Proc. U. S. Nat. Mus., 1883, p. 96). This species has a furcate basal end, well adapted for fixation in a muddy bottom. Mr. Stearns also brings together numerous accounts tending to prove that Pennatulids with simple axial rods have considerable swimming powers. ——A recent memoir of the Museum of Comparative Zoölogy is devoted to the Porpitidæ and Velellidæ. Professor Agassiz

considers this small group of Hydrozoa, which is found wherever the influence of the Gulf Stream extends, to have greater affinity to the Tubularians than to the Siphonophoræ proper. *Velella mutica* is extremely abundant in the Straits of Florida, and sometimes finds its way north to Newport and Nantucket. It is larger than the Mediterranean species. The young differs greatly in appearance from the adult. The Florida Porpita, *P. linneana*, is also much larger than the Mediterranean species. In nearly all the Tubularians the base of the cœnosarc extends either as filaments or rootlets over a considerable space; these filaments are tubular, and, in Hydractinia especially, the base of the cœnosarc resembles in structure the float of Porpita. The great difference is that in the Porpitidæ and Velellidæ the extension of the cœnosarc is consolidated into a float from which the polyps depend.

Worms.—M. Megnin has contributed to the Bull. de la Soc. Zoölogique a study of the organization and development of Echinorhynchus, the most important result of which study is the proof of the existence in the larvæ of a well-developed digestive apparatus which atrophies without completely disappearing in the adult. In the latter the great development of the reproductive apparatus and the pronounced activity of the generative functions overshadow all other functions. The presence of a bifurcated intestine brings Echinorhynchus nearer the Trematodes and removes them from the Nematodes near which there was a tendency to place them.

Tunicates.—W. K. Brooks (Zool. Anzeiger, May, 1882) claims that the solitary Salpa is a true female, which produces a chain of males by budding and discharges an egg into each of them before birth. These eggs are impregnated while the zooids of the chain are very small and sexually immature, and they develop into females which give rise to other males by budding. Thus there is a remarkable difference in the mode of origin of the two sexes, but since both are the offspring of the solitary Salpa, one by budding and the other by sexual reproduction, it is not a case of alternation of generations. This view, first put forth in the Bull. Mus. Comp. Zoöl., No. 14, is again asserted in answer to Salensky, who claims that what Professor Brooks styled an ovary is but a mass of undifferentiated embryonic cells which gives rise both to the ovaries and to the digestive organs of the chain salpæ. Examination with a high power proves, however, that the organ is a true ovary containing eggs, while the digestive organs of the chain salpæ are not formed from it.

Crustacea.—In the Proc. U. S. Nat. Museum Professor S. I. Smith gives a list of the Crustacea dredged upon the coast of Labrador by the expedition under the direction of W. A. Stearns, and also gives a review of the marine Crustacea of that region,

including those collected by Professor Packard in former years. ——In the transactions of the Kansas Academy of Science F. W. Cragin gives the results of his studies of the Copepoda of the fresh waters about Cambridge, Massachusetts. After premising that the genus Cyclops has been the *bête noire* of American naturalists, since, though upwards of sixty valid species have been described in Latin, German, Danish, Dutch or Russian, only three were previously recorded from North America, he proceeds to identify six previously-described species, and to describe four more. The paper concludes with a translation of Poggenpol's descriptions of eight species of Cyclops.——The report by Mr. Harger upon the Isopoda dredged on the east coast of the United States during 1880, by the U. S. Coast Survey steamer *Blake*, contains descriptions of *Cirolana impressa*, *Rocinela oculata* and *Syscenus infelix*, all new species, and of four other little-known species.——MM. Regnard and Blanchard contribute to the Bulletin of the French Zoölogical Society proofs of presence of hæmoglobin in the blood of Apus. The blood of this crustacean is red, though less so than that of a vertebrate, and can be seen through the carapace at the anterior extremity of the animal. Spectroscopic examination showed that the red color is due to hæmoglobin, which is, however, as appears to be the rule in invertebrates possessing it, dissolved in the plasma.

Arachnides.—M. Megnin (Bull. de la Soc. Zoöl. de France) contributes some further information respecting *Cheyletus heteropalpus*, one of a group of Trombidians which live among the roots of the hairs of mammals, or under the feathers of birds, not to absorb the blood or the secretions of their hosts, but to chase and kill their real parasites. *C. parasitivorax* lives among the hairs of the rabbit in order to devour the Listrophores parasitic upon them, while *C. heteropalpus* and *macronychus* capture the Sarcoptidæ of birds. While dissecting a *Cardinalis fulgens* M. Megnin perceived numerous white spots upon the central part of the skin of the breast, and upon examination found them to be composed of fine interwoven fibers, covering a group of eggs in different stages, together with some recently hatched young which could be identified as *C. heteropalpus.*

Fishes.—Twenty-five new species of fishes from Florida are described in the Proceedings U. S. Nat. Museum (Sept., 1882), and Messrs. Jordan and Gilbert describe a new goby from Vancouver's island.——J. A. Ryder (Bull. U. S. Fish Commission, Sept., 1883) has a note on the thread-bearing eggs of Menidia. The eggs of this little fish have four long filaments attached to a small area on one pole; each of these threads is about eight times the length of diameter of the egg, and is apparently composed of the same tough material as that of the egg-membrane. These filaments uncoil from around the egg after oviposition, and as they have a

tendency to entangle with those of other eggs so as to form bunches or strings, Mr. Ryder suggests that they may be the means by which the parent fish is enabled to suspend its ova to the stems or leaves of plants. The ovary of a full-grown Menidia does not contain more than 300 eggs, while the silver-gar, the eggs of which have filaments scattered over the whole surface, contains 800 to 1000 ova. He notices that the number of ova produced by fishes is in some way proportioned to their chances of survival, and that in this respect species with thread-bearing eggs hold an intermediate position.——The same naturalist has an interesting notice of the breeding habits and development of *Amiurus albidus*, as exhibited by examples in confinement. The eggs were about 2000 in number, and formed a mass about eight inches long, four inches wide and one-half to three-fourths of an inch thick. Their surfaces were adherent but not gelatinous, so that intervening spaces remained between them for the passage of water. The female took no further notice of the eggs after depositing them, but the male watched carefully over them until the young had escaped from the egg-membranes, hovering over the mass and forcing fresh water through it by the rapid vibration of anal, pectoral and ventral fins. All of those left in his charge came out, while an attempt to hatch a portion of them artificially was less successful. The water-space in the egg was from the first filled with a great number of free corpuscles, a character not before met with (so far as Mr. Ryder is aware) in any other Teleostean egg. From the sixth to the eighth day the young were hatched, and on the fifteenth would feed. The parent fishes would often take into their mouths pieces of the liver thrown to the young, together with the young that were hanging to them, but it was observed that the young fishes were invariably ejected uninjured.——An elaborate and richly illustrated memoir of a hundred pages, on the brain of the lamprey eel, by F. Ahlborn, appears in the *Zeitschrift für Wissens. Zoologie* for Nov. 6. It treats not only of the morphology, but also of the cellular structure.——*Nature* records the fact that Mr. Morton states that *Ceratodus forsteri* in Mary's river, Queenland, from June to August goes in pairs, that they make slight indentations in the muddy bottom in from six to ten feet of water, in which the spawn is deposited; the male and female fish remain near the spawn, and are not then easily disturbed. They frequent the same place every year, and the spawn is like that of frogs. Mr. Morton has taken it and hatched it in a tub of water, keeping the young alive for some weeks.——In his paper on the oviducts of the smelt, in the Proceedings of the Zoölogical Society, Professor Huxley, after stating that, as is well known, Lepidosteus presents an example of a Ganoid with oviducts like those of the higher Teleostei; in the smelt, on the other hand, "we have a Teleostean with oviducts like those of the ordinary Ganoidei." He concludes that "there are no two

large groups of animals for which the evidence of a direct genetic connection is better than in the case of the Ganoids and Teleosteans. Two other supposed distinctive characters between these two groups have been shown to be not well founded, as Boas has recently discoverd a *conus arteriosus* in Butirinus and other bony fish, while a spiral valve was long ago discovered by Valenciennes in a bony fish (*Chirocentrus dorab*). Moreover, Huxley claims, with Balfour, that in the brain of Lepidosteus the epithalami "become exactly similar to the so-called 'cerebral hemispheres' of the bony fishes;" he then adds, "In all the Teleosteans, in fact, the bodies called 'cerebral hemispheres' are not the exact equivalents of the structures so named either in the higher Vertebrata or in the Selachians, but are *epithalami*, just as in the Ganoids. Thus, in cerebral structure, as in other respects, the Ganoids and the Teleosteans are as closely related to one another as they are different from the Selachians."

Batrachians and Reptiles.—Prof. E. D. Cope (Proc. Acad. Nat. Sci. Phila.) contributes considerable additional information respecting the geographical distribution of various batrachians and reptiles in Western North America. Among other results, the range of *Spea hammondi* is extended to the Rocky mountains, a new Scaphiopus is described from the Great Basin, and *Rana pretiosa* is proved to extend into that district. The Northern Pacific fauna, especially represented by *Bascanium vetustum*, *Rana pretiosa*, and *Bufo columbiensis*, extends in Idaho to the Rocky mountains. A comparison of the principal families and genera of cold-blooded vertebrata found in the Nearctic, Sonoran, and Neotropical regions is given, in order to show the far greater relationship of the Sonoran to the Nearctic than to the Neotropical.

Birds.—In the proceedings of the Zoölogical Society, Mr. W. N. Parker states that on the whole the respiratory organs of the South American ostrich (Rhea) very nearly resembles that of the Carinate birds; but in several points it shows an intermediate condition between the latter and Apteryx.——The Bulletin of the Nuttall Ornithological Club for Jan., 1883, contains, among other good articles, notes on a lateral hermaphrodite green-tailed towhee, though in plumage it resembled the females. B. F. Goss describes the breeding habits of Maximilian's jay and Clarke's crow, and G. Holtenhoff, Jr., describes the nest and eggs of LeConte's thrasher. ——Mr. N. C. Brown has found specimens of *Zonotrichia albicollis* unquestionably in their first year, but clad in a dress practically identical with that of the maturest spring birds. He also finds that males of the two North American species of Loxia often assume their full reddish dress in the autumn of their first year.——Polygamy in the blue bird and marsh blackbird is recorded by Professor F. E. L. Beal. In the April number the vernal migration of warblers on Wolf river, Wis., is described by F. L. Grundtvig.——A hybrid sparrow (*Zonotrichia albicollis* + *Junco hiemalis*) is discussed by

C. H. Townsend, while Mr. J. A. Allen notes certain exceptions to the law of increase in size northward among North American birds.——The July number contains faunal lists and notes, with some notes on habits.——Dr. Coues records, through G. F. Crook, a curious case of susceptibility of a caged red linnet to color. If anything blue is shown, it becomes terribly excited, and utters painful cries.——H. W. Henshaw records an instance of semi-domestication of the California quail, while F. Stephens describes a California bird-crane, *Dendræca occidentalis*, being the most abundant migrants.——A supplementary list of the birds collected by Dr. Dybowski, in Kamtschatka, given in a recent issue of the Bull. de la Soc. Zoöl. de France, raises the total number, including the swimming birds, to a hundred and thirty-four. A new species of Astur, *A. candidissimus*, is described, also *Hirundo kamtschatica*, a species of Troglodytes, and *Phyllopseuste homeyeri*. ——In the Proc. U. S. National Museum, Mr. R. Ridgway describes *Psaltriparus grindae* and *Junco hairdi*, also a new variety of *Lophophanes inornatus*, all from the MS. of and from examples sent by Mr. L. Belding from Lower California. *Anthus cervinus* Pallas, before thought to be exclusively Asiatic, is also noted as occurring in Lower California.

PSYCHOLOGY.

INTELLIGENCE OF THE CAT.—One of the attractions of my home has ever been the number and variety of the pets we have kept, and to which liberty has generally been accorded. Thus they had an opportunity to develop their natures without great restraint; and I, to gratify my love for the observation of character in animals. Prominent among these pets were gophers, chipmunks squirrels—black, gray, red and flying—robins, mocking-birds, cats and dogs, which were entirely free, and a robin, several canaries, a fox, a bear, a bald-headed eagle, and several owls which were somewhat curtailed in their privileges.

As the intelligence of the cat has called forth some notice of late, let me add a few facts which have come under my observation. On introducing a new puss into the "happy family," I found that notwithstanding her reputed treacherousness and selfishness, a few kind, decided words, with considerable watching, and an occasional gentle spat, so well convinced her of the rights of others, that so far as those individuals are concerned in about two weeks she was conquered, and could be trusted to be in a room or out of doors alone with them. A young snipe being brought me, and all my efforts at taming it proving futile, for it *would* run away, I wanted the old cat to catch and have it. She would not touch it, helped us to "corner" it, but would not bite it, and after it was killed, she still refused to eat it, seeming to recognize it as one of her clan.

Many think cats have a memory of places only and not of per-

sons and things. Of the contrary we had proof. One summer during our absence, the house and pets being left with a faithful servant, Dick, a rare and highly prized canary, escaped by a loose wire in his cage. Kit saw him, but did not recognize the bird in the tree, as the canary of the cage, so caught him, and as usual with her prey came to the house to be praised. The girl saw little Dick and taking him away—though dead—suddenly seized the cat, and attempted, with a hatchet, to cut her head off. Fortunately for Kit, the edge was dull and the aim poor, so only a little fur was cut, and she escaped for dear life to the barn. From that time on, only faint glimpses of puss were seen for nearly a month, despite kindly calling, and coaxing morsels, but on our return, we had not been in the house a half hour before puss came in so delighted to see and welcome us. From that day till two years after when she died, every time the deathly hatchet was taken up by the girl to split kindlings, pound steak, or what not, the cat would rush away as though pursued. The rest of the family could use the same hatchet, and for the same purposes as much as we pleased and she would sit quietly by.

We have had another illustration of personal attachment and not merely local. A neighbor had a house cat five or six years old. The family removed, leaving Tip behind, and another family came in. Tip forthwith forsook the house and came to our barn, but would allow none of us to rub him for two years and a half. Finally, as the winter of '81–2 (which proved so very cold) approached, we found him at our door begging entrance. Like one who had gathered up some grains of wisdom, he immediately accommodated himself to his new surroundings, and we could scarcely get rid of him at all, but when spring came, and the family, now absent three years, returned, Tip was missing and we found him safely ensconsed in his former home, nor has been back to us but *once*, seemingly, to bid us good-by. Was it the consciousness that he was old and infirm, unable to stand, unaided, the severities of the approaching winter, or had our cats told him of their kind home that he thus applied at our door for support and protection? It was surely memory of persons rather than mere place which induced his final return to his rightful owners.

Notwithstanding our old mother cat was usually so careful and rarely disobeyed, one Sabbath we left her alone by mistake in a room where were some freshly mounted birds. On our return from church we saw the floor strewed with feathers and divined the cause. She had torn and chewed the poor skins into a forlorn sight, and was herself very sick from the arsenic, corrosive sublimate, &c., used on the skins. We instantly forced her to swallow a supply of fresh lard and white of egg, and succeeded in overcoming the poison so that she recovered. Her appetite was poor, and she seemed to have difficulty in eating. After several

weeks we examined her mouth and to our surprise *every tooth had dropped out.* We thought we should have to kill her, but she seemed to be growing better, so we let her live. Always a great mouser, after this she could only catch the mice and rats, and conscious of her inability to bite them, brought them to us to kill, scratching at the door and making a certain mew which indicated she had something. The man used frequently to take her to the oat bin, and she would catch the intruders there as fast as ever, bringing each one to him to finish. We kept her for two years after this serious experience, always feeding her bread and milk, and bread and coffee and cutting her meat up very fine for her. She then sickened and soon was consigned to the garden Necropolis of the "happy family."

Do not these facts further demonstrate a goodly degree of intelligence in the cat?—*Mary E. Holmes, Rockford, Ills.*

Sense Discrimination.—In a chapter on sensitivity, Galton, in his "Inquiries into Human Faculty." concludes that contrary perhaps to the usual impression. a delicate power of sense discrimination is an attribute of a high race, and that it has not the drawback of being necessarily associated with nervous irritability. The discriminative faculty of idiots is curiously low, they hardly discriminate between heat and cold, and their sense of pain is so obtuse that some of the more idiotic seem hardly to know what it is. Galton found that as a rule men have more delicate powers of discrimination than women, and that the business experience of life seems to confirm this view. For example, the tuners of pianofortes and the tasters of wine and tea, the sorters of wool and the like, are men.

Experimenting on a number of boys at a large educational blind asylum, he found that the blind lads who showed the most delicacy of touch, barely reached the mediocrity of the various sighted lads of the same age whom he had previously tested. He finds that the guidance of the blind depends mainly on the multitude of collateral indications, to which they give much heed, and not in their superior sensitivity to any one of them. Those who see do not care for so many of these collateral indications, and habitually overlook and neglect several of them.

Notwithstanding many travelers' tales, Mr. Galton has thus far been unable to obtain satisfactory evidence of any general large superiority of the senses of savage over those of civilized men. "My own experience, so far as it goes, of Hottentots, Damaras and some other wild races, went to show that their sense discrimination was not superior to those of white men, even as regards keenness of eyesight."

A pair of Catastrophes.—*Prudential killing by a Cat.*—A cat near Red Bank, N, J., last month had a litter of kittens, one of which was a monstrosity. It had seven legs, of which one had

two feet. It had two bodies joined at the one neck, which supported one head, which had two mouths, one under the other. After a few hours the mother cat deliberately killed the kitten by biting it through the neck. Surely this was the exercise of the mother's reason on the line of the survival of the fittest.—*S. Lockwood.*

Feline Prescience.—I must give a fact which was communicated to me many years ago by an old physician, of which the good old man assured me he was an eye witness. In his house were two cats, each with a litter of kittens but a few days old. One of the cats was very young, it was her first litter, and the older cat was her mother. It was noticed that the younger cat did not seem well. Each one had her litter by herself, although both were in the same room. As the old cat lay suckling her own litter, the young cat came to her mother and made a low mewing, then went to her own litter. The old cat followed her and immediately began removing the grand-kittens, adding them to her own. The truth was she had adopted them, and seemingly at the request of their mother, for not many minutes more had elapsed before they were orphaned by their mother's death.—*S. Lockwood.*

Poetry in Dreams.—It is not unusual for persons addicted to dreaming to compose verses, blank or rhyming, but it is rarely that such productions are remembered on waking. A near relative of one of the editors, known by his family to possess considerable facility in this direction, frequently dreamed in verse. On a few occasions he remembered a few lines of these productions. We append them as curiosities. The first is single line:

"The copest leaves do hum exasperated horrors round!"

The second:

"The ship of the desert is vanished forever,
Like music dried up in the bed of a river."

Another:

"Emaciated swallows floating through the air,
Two legs flung out behind, and two before."

—*C.*

ANTHROPOLOGY.[1]

Chinese Coins in British Columbia.—In the summer of 188[illegible] a miner found on De Foe (Deorse?) creek, Cassiar district, Br. Columbia, thirty Chinese coins in the auriferous sand, twenty-five feet below the surface. They appeared to have been strung, but on taking them up the miner let them drop apart. The earth above and around them was as compact as any in the neighborhood. One of these coins I examined at the store of Chu Chong

[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

in Victoria. Neither in metal nor markings did it resemble the modern coins, but in its figures looked more like an Aztec calendar. So far as I can make out the markings, this is a Chinese chronological cycle of sixty years, invented by the Emperor Huungti, 2637 B. C., and circulated in this form to make his people remember it.—*James Deans.*

Fuegian Ethnology.—Professor A. H. Keane, in *Nature*, August 9, reviews a paper in Guido Cora's *Cosmos* for May, written by Lieut. Bove, of the Italian Antarctic expedition, in which occur some interesting details on the Fuegians. The archipelago is occupied by three races, the Alacalufs in the west, the Onas in the east, and the Yagans in the south. The latter, extending from the north side of Beagle channel southward to Cape Horn, appear to be the true aborigines, driven to their inhospitable islands by the other two tribes intruding from the mainland. The Onas, who are clearly of Tehuelche origin, penetrated from Patagonia across the eastern arm of Magellan strait into the large island of King Charles South Land. The Alacalufs, of Araucanian stock, made their way from the Chilian Andes, across the western arm of Magellan strait into the islands from Cape Pillar to Stewart island. The Onas number about 2000, the other two about 3000 each. The Yagans appear to have been originally of the same stock as the Alacalufs, they are below the middle height, though nearly as tall as the Araucanians. They are distinguished by low brows, prominent zygomatic arches, large pendant lips, flat nose, round face, loose, wrinkly skin, thin extremities, legs curved outward, hair coarse, lank, long and black, with few exceptions. They neither tattoo nor paint, and are scantily clad. Their houses are wretched hovels, but their beechwood canoes are skillfully made. In these frail craft they navigate the stormy channels, pursuing the whale and the dolphin beyond sight of land. The Yagans are polygamists and exacting of their wives, who are prolific, however, and industrious. Many children succumb to the climate, and those who survive soon shift for themselves. Little of social organization exists beyond the family and the hunting party. The belief in the supernatural and in a future existence seems to be little developed. The statement that the language contains 30,000 vocables is received by Mr. Keane with extreme caution.

The Atlantis.—M. E. F. Berlioux, professor of geography in the faculty of letters, Lyon, has just published a learned work entitled "Les Atlantes: histoire de l'Atlantis et de l'Atlas Primitif, ou Introduction a l'histoire de l'Europe" (Paris, Ernest Leroux, 1883, pp. 170, 8vo). The question of Atlantis rests upon an Egyptian tradition related by Solon, and preserved by Plato in the Timæus and the Critias. For all the events related in this tradition, the dates and the geographical positions, there is always

a double interpretation, one giving to the statements exaggerated meanings, the other regarding them as ordinary facts accessible to discussion. Now students have considered the subject from the first point of view only, regarding Atlantis as a continent in the center of the Atlantic ocean, from which a great expedition was made nine or ten thousand years before our era, and which was one day engulfed in the sea. In this form the legend is so seductive to the imagination as to place patient research out of the question. Even those who have given any historic value to the narrative have placed the events so far back as to antedate criticism.

In fact, the lands of the Atlas are not only rich in souvenirs found in books, but they are filled with monuments some of which belong to the most remote ages and of which it becomes us to study the history. The dolmens are more numerous than those of Armorica, and it is here that we must seek one end of that long line of megalithic monuments whose other extremity is to be found in India. The tumuli mark a second epoch, and their lines are not arrested by the ocean, they reappear on American soil. Along side of these rude structures appear the remains of others belonging to a still higher civilization. Indeed, M. Berloux has sought to reconstruct the history of this Northeast African land. Those of our readers who attended the Montreal meeting of the American Association will recall Mr. Haliburton's paper on the same subject, and they will be pleased to know that Mr. Haliburton is at this time traversing the edge of the Great Sahara with the classic authors in his hand.

The German Anthropological Society. — The fourteenth general meeting of the German Anthropological Society was held the present year at Trier, on the 9th, 10th and 11th August, Professor R. Virchow, president. The preliminary programme is devoted to the general business of the meeting, and mentions only a few of the papers to be read.

The Western Scientist.—Ottumwa, Iowa, is to be the home of a new periodical devoted to science, and Mr. Crawford is to be the editor. The first number presents a comely appearance, though most readers object to quarto periodicals. Mr. Samuel B. Evans contributes a paper on the Des Moines Valley mounds.

The Great Index Catalogue.—Volume iv of the "Index Catalogue of the Library of the Surgeon-General's Office, U. S. Army," has just appeared. There are two things in these volumes which we recommend to all anthropologists. The first is the alphabetical list of abbreviations of periodicals and societies; the whole subject is in dire confusion elsewhere, but here it is reduced to a rigid system. The second valuable thing is the great number of references to matters eminently anthropological. In

the present volume one should examine the words, *ear*, *Ecker*, *education*, *embalming*, *embryology*, *emigrants*, *emotions*, *engineering* (sanitary), *epidemics*, *ethics of medicine*, *ethnology* (seven pages), *eunuchs*, *evidence* (medical), *evolution* and *face*. Indeed many anthropological references occur under more general words, such as *eye*, *face*, etc.

INDIAN NAMES OF WATER-COURSES.—Some one has said that the perishable is, after all, the most enduring. There is nothing in art more fragile than pottery or glass, yet either of them in its fragments outlasts bronze or marble. The same is true of words. Some of the tribes once puissant in the States east of the Mississippi have absolutely faded from the earth, yet they have left the evidences of their former power in the names of the natural features. Mr. H. W. Beckwith, of Danville, Illinois, has done a good service in publishing a list of these names for Indiana, in the State Geological Survey for 1882. Many of the titles were collected and defined by the late Daniel Hough. An excellent map accompanies the paper.

THE MAUMEE.—Ottawasepoie, *Ottawa river*, by the Shawnees. Cagharenduteie, *River of the standing* rock, by the Wyandottes.

THE ST. MARY'S.—Cokothekesepoie, *Kettle river*, by the Shawnees.

THE WABASH.—Wauba, *white*, and Wabish ,*water*, in Algonkin. Quiaaghtena, in Iroquois.

THE MISSISSINEWA.—From missi and assin, with ewa, inanimate termination, signifying *River of great stones*.

TIPPECANOE.—Kenonge, *the long-billed pike*.

RED-WOOD CREEK.—Musqua-metgi-sepe, *Red-wood river*, in Ojibwa.

PINE CREEK.—Puckgwunnashgamucksepe, *white pine tree of the bark-peeling kind*, in Ojibwa.

WILDCAT.—Pishewa, in Shawnee, Ojibwa and Miami.

KANKAKU.—Theakiki, *wolf land*, in Mohegan.

IROQUOIS.—Mockabella, from moqua, *bear*, in Kickapoo. Pickamink, *beaver*, in Pottawattomi.

BEAVER LAKE.—Sagayiganuhnickyug, *the lake of the beavers*.

WHITE RIVER.—Opecomeecah, in Delaware.

VERMILION.—Piaukeshaw, *red earth, burnt earth*.

EEL RIVER.—Kenabegwinnmaig, *Snake-fish river*.

OHIO.—Oio, *beautiful*, in Iroquois. Akanseas, by Allianies and Illinois, because the Akanseas formerly dwelt upon it.

THE KANAKAS OF NEW CALEDONIA.—The people of New Caledonia are the subject of a paper by Baron L. de Vaux, who has added to his own experience the knowledge gained by consulting the works of others. The islands are not remarkable for the luxuriance of their tropical growth, because the geological formation is not favorable. The people of to-day also seem to be in a state of degradation, not being engaged in those great and elaborate enterprises which distinguished their ancestors, such as long aqueducts, terraced plantations of ignames, fortifications, etc. The New Caledonians are not so dark as the Negroes, but more

darkly colored than the Polynesians. They have crisped hair, salient lips, noses artificially flattened, and the ears pierced in the lower lobe. The beard is quite abundant, although many do not allow it to grow. They wear no clothing. The height of the women, poor creatures who are only beasts of burden, is below the mean. Pretty up to the fifteenth year, they soon become decrepid by reason of severe toil and harsh usage. Old age is rare. Frequent wars, chronic diseases, epidemics, carelessness about the laws of health, sudden changes of occupation, and above all, the enfeeblement of the mothers, are sufficient to account for the brevity of life. The women belong to the tribe and to their purchasers, hence courtship and marriage in a true sense are unknown. Betrothals take place early, and are effected by the exchange of gifts, they are binding only when the bachelor sends to his fiancée a collar of a certain pattern. Finally, to complete the engagement, both drink from the same cup a fermented liquor specially prepared. Infidelity in the wife is punished by precipitating her from a celebrated cliff. The pastimes of the men consist of athletic sports, and they drive away dull care with the music of a rude flute and the recitation of ancient legends. One of their favorite weapons is the *sagaie*, which they hurl by means of a short cord, looped at one end for the forefinger, and knotted at the other to make fast temporarily to the shaft. Those who have seen a seine landed by men with just such a looped and knotted cord passed around their shoulders and wrapped once around the seine rope, will understand the working of this savage sling. The paper of Baron de Vaux abounds in useful information which the want of space does not even permit us to mention (*Rev. d'Ethnog.*, II, 327-354).

FRENCH ETHNOLOGY.—The fourth part of Vol. II, *Revue d'Ethnographie*, Paris, contains the following original memoirs:

The Ghiliaks, from the latest sources of information. By J. Deniker.

The use of Mollusks among ancient and modern peoples II. Mollusks of the tombs of Equador and New Guinea (6 figs.). By A. F. de Rochebrune.

Ethnographic observations in the peninsula of California and Sonora (5 figs.). By H. Tenkate.

The Kanakas of New Guinea (13 figs.). By Baron L. de Vaux.

The Ghiliaks are that people who live at the mouth of the Amoor and on the adjacent shore of Saghalin. They belong, with the Yukagirs, etc., to the vast family of tribes called by Schrenck the Paleasiatics.

The use of mollusks among the S. American aborigines of the Pacific coast was very restricted, both as regards species and classes of specimens, and this fact is more apparent in Ecuador and New Grenada, than in Peru.

The southern peninsula of California is almost devoid of interest to the anthropologist. Ancient relics are rare, and the pure

blood Pericuis and Coras give place to mixed-bloods, in which the foreign element has almost entirely obliterated every aboriginal trace.

The Kanakas of New Caledonia are of Negrito stock, and the Baron de Vaux has diligently supplemented his own personal observations by the study of original authorities.

The last thirty pages of the number are devoted to reviews, reports of meetings, expositions and collections, correspondence, news and bibliography.

The third part of Vol. XVI of *Rev. de Linguistique*, Paris, is devoted entirely to Sanscrit and Hindustanee.

The second fascicule of the *Bulletins de la Société d'Anthropologie de Paris*, publishes the following papers of general interest:

On the poisoned arrows of the North American Indians. By G. Lagneau.

Discussion upon Polyandry in Asia—Kachmir and Thibet. Study in ancient and modern ethnography. By O. Beauregard and M. de Ujfalvy.

Anatomical significance of the chief humeral of the biceps muscle. By M. Leo Testut.

On the races of Oceanica. By M. Cauvin.

Report on the brain of Louis Asseline. By MM. Mathias Duval, Chudzinski and Hervé.

Discussion upon the poisoned arrows of the North American Indians. By. MM. Prat and G. de Mortillet.

The traces of ancient religions in Central Asia and to the south of the Hindoo Koosh. By Ch. E. de Ujfalvy.

Morphologic description of the brain of Assezat. By MM. Mathias Duval, Chudzinski and Hervé.

Upon the "Tablier" and steatopygia among the Bushman women. By Dr. Raphael Blanchard.

Human sacrifices among the Khonds of India. By E. Reclus.

The population of Western Laos. By Carl Bock.

Discussion upon the Couvade among the Basques. By J. Vinson and G. Lagneau.

Morphological description of the brain of Coudereau. By MM. Duval, Chudzinski and Hervé.

Influence of alimentation upon the milk. By G. de Mortillet.

The prehistoric Passo. By M. Chauvei.

The most interesting papers of general interest are the reports on the brains of Louis Asseline, M. Assezat and M. Coudereau.

THE CONGRESS OF AMERICANISTS. — In 1875 a gathering of Americanists took place at Nancy, France, and organized the Congrès International des Americanistes, which has assembled by adjournment every two years since that date—once each at Brussels, Luxembourg, Madrid and Copenhagen.

In 1883 the session began at Copenhagen on August 21st. It was opened with all due formality in the magnificent hall of the university, in the presence of the king, the royal family, the Princess of Wales (then on a visit to her parents), the chief ministers of State, and many distinguished visitors and citizens. Official delegates were present from the governments of Denmark, France, Belgium, Spain and Italy, and from learned societies in

Germany, Colombia and the United States, though we regret to say that our own country had only one representative at any time during the congress.

The opening session was presided over by the eminent archæologist, Professor Worsaae, who delivered the address of welcome. He referred to the close relations which Scandinavia and Denmark had maintained, for nearly a thousand years, with Iceland, Greenland and Northern America, described some of the voyages of the Northmen, and called attention to a model of one of their ancient ships which was exhibited in the hall. He was followed by M. Fabie (the delegate from Spain), M. Lucien Adam (from France), and M. Anatole Bamps (from Belgium). The address of the latter gave a brief but masterly sketch of the evidence of the existence of palæolithic man in America, and asked the especial attention of the congress to this subject. Not only, said the speaker, is the testimony now ample that man existed in America at the close of the glacial epoch, but we are even justified in saying that from a comparison of similar discoveries in the two hemispheres, the human race appears to have occupied America at an epoch anterior to any of which we have yet evidence in Asia or Europe.

At the session of the following day, the same topic was brought up by M. Lütken, who described the human remains found in caverns in Brazil by the late Dr. Lund. They were intimately associated with the bones of extinct animals, and gave proof of a high antiquity. M. Reiss, of Berlin, described similar results from his own researches in Brazil and in Buenos Ayres.

A variety of new materials for the history of Columbus's voyages was epitomized by M. Herrera, who has collected a mass of unexpected information from unpublished documents in Spain. Thus, contrary to what has been often stated, he shows that Columbus actually landed on the mainland of the continent at a number of points.

During the second day two papers were presented in English. One was by Mr. Löffler, on the discovery of Vinland by the ancient Scandinavians. He refuted the opinion of the historian Bancroft that the Icelandic *sagas* are without historical value, and argued that Vinland should be located as far south as the State of Virginia. The other paper was by Dr. Brinton, of Philadelphia, one of the vice-presidents of the congress, and the only delegate from the United States. It was a sketch of the literature by native authors in the aboriginal tongues of America.

Another paper in English was read the following day by M. Steenstrup. The subject was the ruins of ancient European colonies which are discovered in unexpected spots in Greenland. No record of these settlements remain beyond obscure allusions in the *sagas*, which have been called in question. But it is evident that a much larger population once existed in that inclement

country than at present, and that the references in the *sagas* are quite trustworthy.

On the 23d, a valuable communication was received from Baron Nordenskjöld. The celebrated navigator had directed that each member of the congress should be presented with an engraved *fac-simile* of a map dating from before the year 1482, on which was represented Greenland and perhaps some outline of the northern portion of the continent. For various reasons, he argued that this map was the production of an Italian who had visited the Faroë islands. This chart and the subject in general were ably discussed at a later hour by M. Steenstrup and Admiral Irminger, who threw much light on the origin of the celebrated "map of Zeno." The extensive voyages through the Northwestern waters by the Northmen were further proved in an excellent paper by M. Brynjulfson. He recited an Icelandic poem of about the year 1100, which describes what is now known as Melville bay, and quoted a letter, still extant, of a priest, giving a narrative of his voyage in 1266 as far as what is now Smith's sound. The descriptions of localities in it are so accurate that they can be readily identified.

How it happened that the really extensive geographical knowledge and profitable fisheries, colonies and commercial relations which the Northmen established with Greenland and vicinity between A. D. 1000 and 1450 became neglected and at last forgotten by themselves, was satisfactorily explained in a long and learned memoir by M. Valdemar Schmidt.

In the domain of archæology, two well-prepared papers on native American ceramics were presented by MM. Bamps and Rada. The former announced the important fact that all varieties and colors of American pottery, from the elaborate workmanship of Peru to the rude efforts of the hunting tribes, are invariably of one uniform *pâte*, not of several different colors or consistencies. Whatever differences there may be due to the mixing of the clay, to the burning, to external coloring, or other such extrinsic treatment. The decoration of native pottery, as well as the theory of aboriginal ornamentation in general, was discussed in an entertaining paper by M. Stolpe.

It has long been known that various savage tribes perform an operation on the skull similar to that called by surgeons "trephining." The occurrence of this in several American nations was described by M. de Baye.

The changes of level in the different parts of the American continent, and their effect on population, were shown by M. Vera, who brought together many striking facts to illustrate the vast geologic oscillations which are in progress.

In American linguistics, the principal contributions were a learned paper by Dr. Rink on the Eskimo tongue, and some remarks on the Kiché and Timucua by other members. The

question of the decipherment of the mysterious hieroglyphs of Yucatan was broached, but it was agreed that little progress had been made in this attractive branch of archæology.

One gratifying fact must be recorded to the credit of those who assisted in this congress. So many antiquaries have made themselves and their study ridiculous by absurd theories, that one always has a dread that this fate will overtake an assemblage of the kind. To be sure, there were a few threatening symptoms of such an outbreak. The Celtomaniac was heard from who wanted to identify some American language with the Welsh, the ancient Atlantis was not wholly submerged out of sight, and the missionary journey of the Apostle St. Thomas to Mexico in A. D. 50 would come up for a little while; but the good sense of the majority soon suppressed these wasters of time.

The occasion was a fine one for practice in languages. The congress has no official tongue, and though most of the proceedings were in French the papers and debates were alternately in that language and in German, English, Spanish and Danish. The sessions closed with an excursion in the picturesque landscapes around Copenhagen, and it is safe to say that every member of the body returned to his home enriched with information on the subject of his studies, and with a sentiment of warm friendliness to the hospitable and intelligent Danish people.

The next meeting of the congress will be at Turin, in 1885.—*D. G. B.*

MICROSCOPY.[1]

Methods of Preventing the Rolling of Microtomic Sections.—The section-smoother described in the last number of the Naturalist appears to be the best instrument yet devised for the prevention of section-rolling, not excepting the ingenious device of Schulze, described below.

Besides the section-smoother, there are other means by which the rolling of sections may be prevented. It may be effected by rendering the paraffine softer and less elastic through the addition of a small quantity of vaseline, by the aid of brush or spatula held over the object by the left hand during the process of cutting, and lastly—and most effectively—by placing the knife at right angles to the carrier. The discovery of the fact that sections may be cut without rolling by giving the knife a transverse instead of an oblique position, was made by Mr. Caldwell, and at about the same time by Professor Mark. Since the discovery of this method, it has come very rapidly into general use, and now Jung's microtome is supplied with "transverse" as well as "oblique knives." This method, excellent as it is, especially with small objects, does not suffice in all cases, and does not therefore remove the necessity of a section-smoother. Even with the

[1] Edited by Dr. C. O. Whitman, Mus. Comparative Zoology, Cambridge, Mass.

knife placed transversely, the section-smoother may often be used with advantage, and sometimes proves indispensable.

In this method it is important to use a moderately soft paraffine, which may be obtained by mixing, in proper proportions, soft and hard paraffine, and further to give the piece of paraffine to be cut a rectangular form. The piece must then be so placed in the holder that the side next to the knife is exactly parallel with the cutting edge. Thus placed, every section lies flat on the blade. The second section pushes on the first, adhering to its adjoining side; the third pushes on the first two, adhering to the second. A whole ribbon of sections may be cut in this way in a few moments without danger of losing their serial order. Thus three very important points are gained: the sections remain perfectly flat, the cutting may be as rapid as the hand can move, and the order of the sections is preserved without trouble to the manipulator. Care must be taken only that the opposite sides of the paraffine are parallel, otherwise the ribbon will curve to the right or left, and the arrangement of the sections on the slide be less easily accomplished.

Schulze's Section-smoother.[1]—This contrivance consists of a small weight supported by a steel spring. The weight (w) which

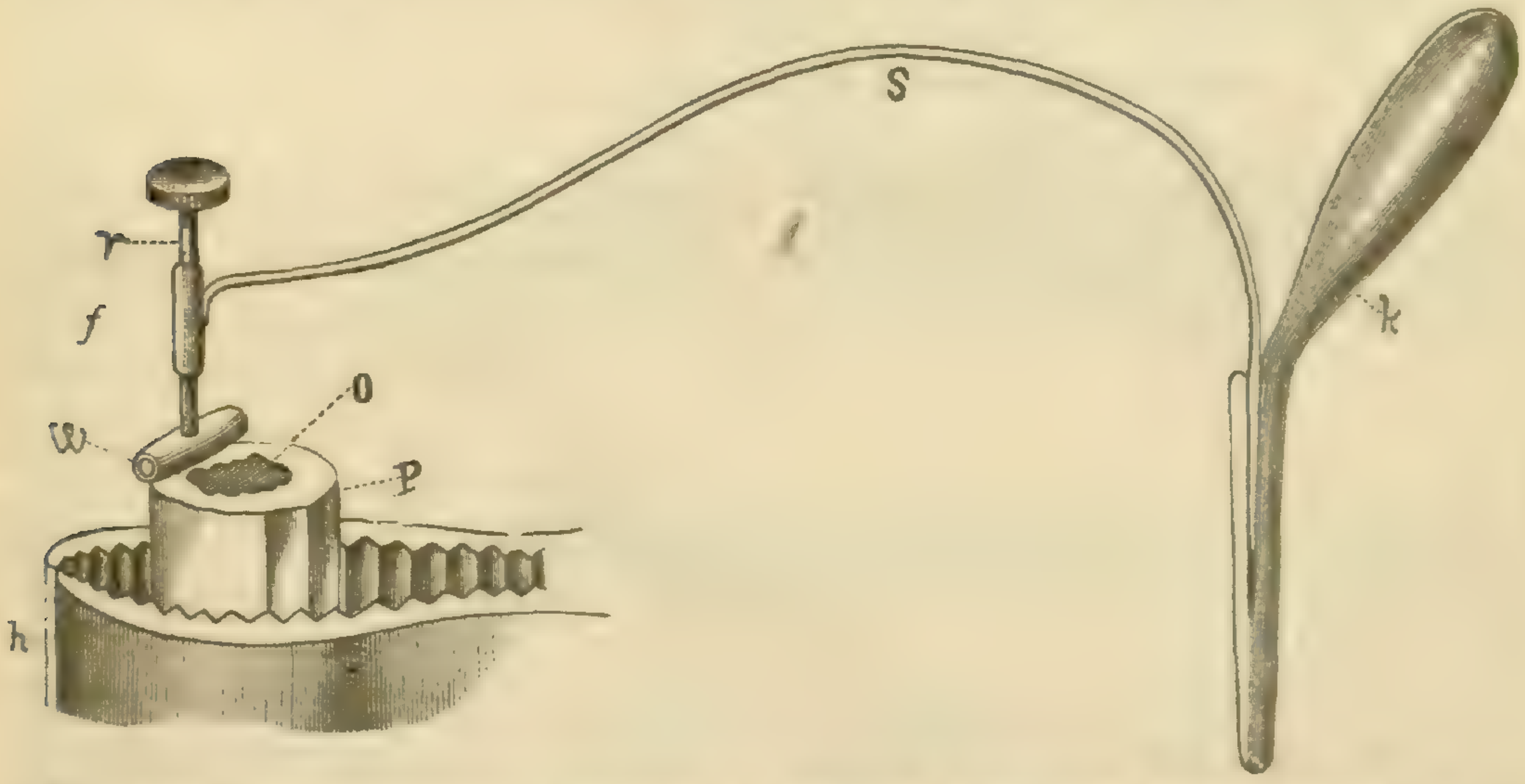


Fig. 1.—Section-smoother adjusted to a block of paraffine (p) preparatory to cutting; o, the object; h, paraffine-holder; s, steel spring; w, weight.

has the form of a cylinder, is about 8^{mm} in length, and is fixed to the lower end of an upright rod which can be turned about its longer axis, or moved up or down in a ferrule (f), as may be seen from the figure. One end of the spring (s) supporting the weight is soldered to the ferrule; the other end is held fast in the holder (k), one arm of which is prolonged into an enlarged handle-like portion. The holder (k)

[1] Franz Eilhard Schulze. Ein Schmittstrecker. *Zool. Anzeiger*, VI, No. 132, p. 100.

fits into a cylindrical hole which penetrates perpendicularly to a depth of 2–3^{mm} the hinder portion of the object-carrier. Within this hole the holder can be turned, or moved up or down; and these movements, together with those which may be given to the rod (*r*) and the spring (*s*), are ample for all adjustments of the weight (*w*).

Preparatory to cutting, the weight should be turned so as to be parallel with the edge of the knife, and raised or lowered by means of the rod (*r*) and the holder (*k*) until it rests *lightly* on the upper surface of the paraffine. Slight changes in the pressure of the weight can be made through the rod (*r*); greater changes can be effected by bending the spring.

The weight should rest, not directly over the object, but on the edge of the paraffine next to the knife.

This section-smoother, which can be fitted to any sliding microtome, can be obtained of Fr. Fasching, in Graz, Bügergasse, No. 13, at a price of 3½ marks, or $0.85.

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SCIENTIFIC NEWS.

— Some Gossip about Darwin.—In a recent visit to England, the writer strolled into the village of Down in Kent, and talked with some of the villagers in regard to Mr. Darwin, whose beautiful home is just outside the little town.

Some of this talk, although in itself idle and valueless, may have an interest to readers, as showing how a great man looks to his smaller neighbors.

The landlord of the "George Inn" said that "all the people wished to have Mr. Darwin buried in Down, but the government would not let them. It would have helped the place so much. It would have brought hosts of people down to see his grave. Especially it would have helped the hotel business which is pretty dull in winter time.

"Mr. Darwin was a very fine-looking man. He had a high forehead and wore a long beard. Still, if you had met him on the street, perhaps, you would not have taken much notice of him unless you knew that he was a clever man."

"Sir John Lubbock (Darwin's friend and near neighbor) is a very clever man, too, but not so clever nor so remarkable-looking as Mr. Darwin. He is very fond of hants (ants) and plants and things."

At Keston, three miles from Down, the landlady of the Greyhound had never heard of Mr. Darwin until after his death. There was then considerable talk about his being buried in Westminster, but nothing was said of him before.

Several persons had considerable to say of Mr. Darwin's extensive and judicious charity to the poor. To Mr. Parslow, for

many years his personal servant, Mr. Darwin gave a life pension of £50, and the rent of the handsome "Home Cottage" in Down. During the time of a water famine in that region, he used to ride about on horseback to see who needed water, and had it brought to them at his own expense from the stream at St. Mary's Cray.

"He was," said Mr. Parslow, "a very social, nice sort of a gentleman, very joking and jolly indeed; a good husband and a good father and a most excellent master. Even his footmen used to stay with him as long as five years. They would rather stay with him than take a higher salary somewhere else. The cook came there while young and stayed there till his death, nearly thirty years later.

"Mrs. Darwin is a pleasant lady, a year older than her husband. Their boys are all jolly, nice young fellows. All have turned out so well, not one of them rackety, you know. Seven children out of the ten are now living.

"George Darwin is now a professor in Oxford. He was a barrister at first; had his wig and gown and all, but had to give it up on account of bad health. He would have made a hornament to the profession.

"Francis Darwin is a doctor, and used to work with his father in the greenhouse. He is soon to marry a lady who lectures on Botany in Oxford.

"For the first twenty years after Mr. Darwin's return from South America, his health was very bad—much more than later. He had a stomach disease which resulted from sea-sickness while on the voyage around the world. Mr. Parslow learned the water-cure treatment and treated Mr. Darwin in that system, for a long time, giving much relief.

"Mr. Darwin used to do his own writing but had copyists to get his work ready for the printer. He was always an early man. He used to get up at half past six. He used to bathe and then go out for a walk all around the place. Then Parslow used to get breakfast for him before the rest of the family came down. He used to eat rapidly, then went to his study and wrote till after the rest had breakfast. Then Mrs. Darwin came in and he used to lie half an hour on the sofa while she or some one else read to him. Then he wrote till noon, then went out for an hour to walk. He used to walk all around the place. Later in life, he had a cab, and used to ride on horseback. Then after lunch at one, he used to write awhile. Afterwards he and Mrs. Darwin used to go to the bedroom, where he lay on a sofa and often smoked a cigarette while she read to him. After this he used to walk till dinner-time at five. Before the family grew up, they used to dine early, at half-past one, and had a meat-tea at half-past six.

"Sometimes there were eighteen or twenty young Darwins of different families in the house. Four-in-hand coaches of young

Darwins used sometimes to come down from London. Mr. Darwin liked children. They didn't disturb him in the least. There were sometimes twenty or thirty pairs of little shoes to be cleaned of a morning, but there were always plenty of servants to do this.

"The gardener used to bring plants into his room often of a morning, and he used to tie bits of cotton on them, and try to make them do things. He used to try all sorts of seeds. He would sow them in pots in his study.

"There were a quantity of people in Westminster Abbey when he was buried. Mr. Parslow and the cook were among the chief mourners and sat in the Jerusalem chamber. The whole church was as full of people as they could stand. There was great disappointment in Down that he was not buried there. He loved the place, and we think that he would rather have rested there had he been consulted."—*David S. Jordan, Bloomington, Indiana*

— Sir A. Henry Layard, in his "Nineveh and Babylon" describes a lens which he found in the course of his excavations, and which is now in the British Museum. By the kind permission of Dr. Birch, the keeper of Oriental Antiquities, the Journal of the Royal Microscopical Society has been enabled to figure it. The lens is thus referred to by Sir A. H. Layard: "With the glass bowls was discovered a rock crystal lens, with opposite convex and plane faces. Its properties could hardly have been unknown to the Assyrians, and we have consequently the earliest specimen of a magnifying and burning glass. It was buried beneath a heap of fragments of beautiful blue opaque glass, apparently the enamel of some object in ivory or wood, which had perished.

A note from Sir David Brewster, quoted by Layard, ends as follows: "It is obvious from the shape and rude cutting of the lens that it could not have been intended as an ornament. We are entitled, therefore, to consider it as intended to be used as a lens, either for magnifying or for contracting the rays of the sun, which it does, however, very imperfectly."

— A monograph of the North American fresh-water sponges is now in course of preparation by Mr. Edward Potts. The best season for collecting sponges varies with the different species, but may be generally stated to be from the last of July to the middle or latter part of November, when the spicules and statospheres are likely to be fully matured. They may be preserved in dilute alcohol or dried by a few days' exposure to the air; in which condition Mr. Potts would be very happy to receive specimens from all parts of this and other countries. If packed in light boxes, strong enough to prevent crushing, the postage by mail (4th class) will be but one cent per ounce, which Mr. Potts will gladly repay, with any other reasonable expenses. He will acknowledge their

receipt, giving the names of known species and full credit to the collectors of all that are novel or interesting. Every gathering should be marked with its habitat, the date of collection, and the name and address of the sender. Address specimens and letters to Edward Potts, 228 S. Third street, Philadelphia.

—We are glad to learn, that Dr. Shufeldt of the army is about to resume his scientific work at the Army Medical Museum of Washington. It is the intention of the recently appointed Surgeon-General, General Robert Murray, U. S. Army, to place Dr. Shufeldt in the position he formerly held in that institution, and his duties in that field will commence at an early date.

Dr. Shufeldt has during the year just past made very extensive collections of vertebrates and invertebrates in the southern part of the State of Louisiana. This collection amounted to some 3000 specimens, and coming as they do from a section of our country so little known and worked by the naturalist, they are particularly valuable. It is to be sincerely hoped that Dr. Shufeldt will be enabled to work up his collection, and duly give us a report upon the zoölogy of the section in question.

—Charles Leslie McKay, U. S. Signal Officer at Nushegak, Alaska, was drowned in Bristol bay, last April, while on a collecting excursion. Mr. McKay was engaged in a zoölogical survey of the Bristol Bay region under the auspices of the National Museum, and had already sent in important collections. He was one of the most active of the younger naturalists, having given especial attention to Ichthyology. His only scientific publication is a review of the *Centrarchidæ*, in the Proc. U.S. Nat. Mus. for 1881. This paper was an abridgment of a detailed monograph, the manuscripts of which have been destroyed by the burning of the museum of the Indiana university. Mr. McKay was a native of Wisconsin, a graduate of Indiana university, 26 years of age and unmarried.—*D. S. J.*

— In the recent death of Dr. W. Kowalevsky, palæontological science has lost one of its most able cultivators. He was professor in the University of Moscow, and was of the purest and most advanced Muscovitic stock. His contributions to vertebrate palæontology mostly appeared in the German Palæontographica, and were of a high order of excellence. He anticipated several English and American writers in several generalizations as to the descent of the ungulate Mammalia, among the rest in the genealogy of the horses.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Nov. 30.—Communications were made by Dr. Frank Baker on the logical method of

teaching anatomy; by Dr. Thomas Taylor on *Oidium tuckeri*, or fungus of the foreign grape vine, with new facts relating to its highest stage of fruit, with illustrations; by Professor Theodore Gill on a new family of deep-sea fishes, the Acanthochænidæ; and by Professor C. V. Riley on the use of naphthaline in medicine and as an insecticide.

NEW YORK ACADEMY OF SCIENCES, Nov. 5.—The relations of Dinichthys, as shown by some recently discovered complete crania, by Dr. John S. Newberry, was the paper for the evening.

Nov. 12.—Dr. Hubbard W. Mitchell delivered a lecture, illustrated with diagrams and stereopticon, upon the succession of animal life on the globe.

Nov. 19.—The following paper was read: Glacial phenomena in the Shawangunk mountains, Dr. Alexis A. Julien.

BOSTON SOCIETY OF NATURAL HISTORY, Nov. 7.—Professor H. W. Haynes spoke of the agricultural implements of the New England Indians; Professor W. O. Crosby read a paper on the origin and relations of continents and ocean-basins; and Dr. M. E. Wadsworth gave brief notes on the lithology of the Island of Jura, Scotland.

Nov. 21.—Mr. William Brewster spoke of the birds observed on the *Arethusa's* cruise to the Gulf of St. Lawrence; and the secretary showed an interesting example of a "home made without hands."

APPALACHIAN MOUNTAIN CLUB, Nov. 14.—Reports of councillors were presented, when the following papers were read: The Reconnaisance of the Carter range, by Miss Edith W. Cook; Crow Nest on the Hudson, by Professor W. W. Bailey; An ascent of the Giant's Stairs, by R. B. Lawrence; A trip over Deception, Dartmouth and Mitten, by George A. Sargent; Mount Parker and Mount Nancy, by Albert Matthews; A visit to the Imp Face, by Miss S. M. Barstow.

At a special meeting, Nov. 20, White Mountain photography was illustrated, by W. H. Pickering; Randolph, by Mrs. L. D. Pychowska; The mountains near Zermatt, illustrated, by C. H. Ames.

A trip to Blue hill was made Saturday, Nov. 10.

AMERICAN GEOGRAPHICAL SOCIETY, Nov. 20.—Mr. George Kennan delivered a lecture entitled, A journey through Southeastern Russia, illustrated with stereopticon views.

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AN ACCOUNT OF THE WAR CUSTOMS OF THE OSAGES,

GIVEN BY RED CORN (HAPA ƆÜISE), OF THE TSIƆU PEACE-MAKING GENS, TO THE REV. J. OWEN DORSEY.

INTRODUCTION.

IN order to obtain a better understanding of the subject, it will be necessary for the writer to describe the order in which the Osages encamped in their tribal circle. When they went on their buffalo hunt in the summer they always pitched their tents in a certain order, according to the clans or gentes of which the tribe was composed. In the first diagram seven gentes camp on the left, and fourteen, considered as seven at present, on the right. Those on the left are the Tsi′-ɔu or Chee′-zhoo gentes, forming the peace element of the tribe; those on the right are the Hañ′-ka and Wa-ɔa′-ɔe (War-shar′-shay)[1] gentes, constituting the war element. The former could not take animal life of any sort, but were obliged to content themselves with vegetable food, till they made an agreement with those on the right to supply them with vegetable food in exchange for meat, which the Hañ-ka and Wa-ɔa-ɔe could obtain.

The Tsi-ɔu (Chee-zhoo) gentes are as follows: 1. Those who wear tails or locks of hair on the head. 2. Buffalo bull face. 3. Chee-zhoo peace-makers or red eagle. 4. Those who carry the sun on their backs, sun carriers. 5. Night people, or the

[1] Wa-ɔa-ɔe or Wa-zha-zhe, means *Osage*. The exact pronunciation cannot be shown by ordinary English characters. Hence the "c" = "sh", is inverted to show a sound between "sh" and "zh."

youngest Chee-zhoo. 6. Buffalo bull; and 7. Thunder people, or those who camp behind.

The gentes on the right are now in seven groups, the seven Wa-zha′-zhe gentes having been consolidated into two groups, and the seven Hañ-ka gentes into five groups. Before this consolidation was made, the tribe consisted of the seven Chee-zhoo fire-places or gentes on the left, and the seven Wa-zha-zhe fire-places on the right.

The following are the groups on the right, according to two authorities, Saucy chief and He-who-never-fails: 8. Elder Osages, including six of the Wa-zha-zhe fire-places. 9. Hañ-ka apart from the rest. 10. Ponka peace-makers (the leading gens

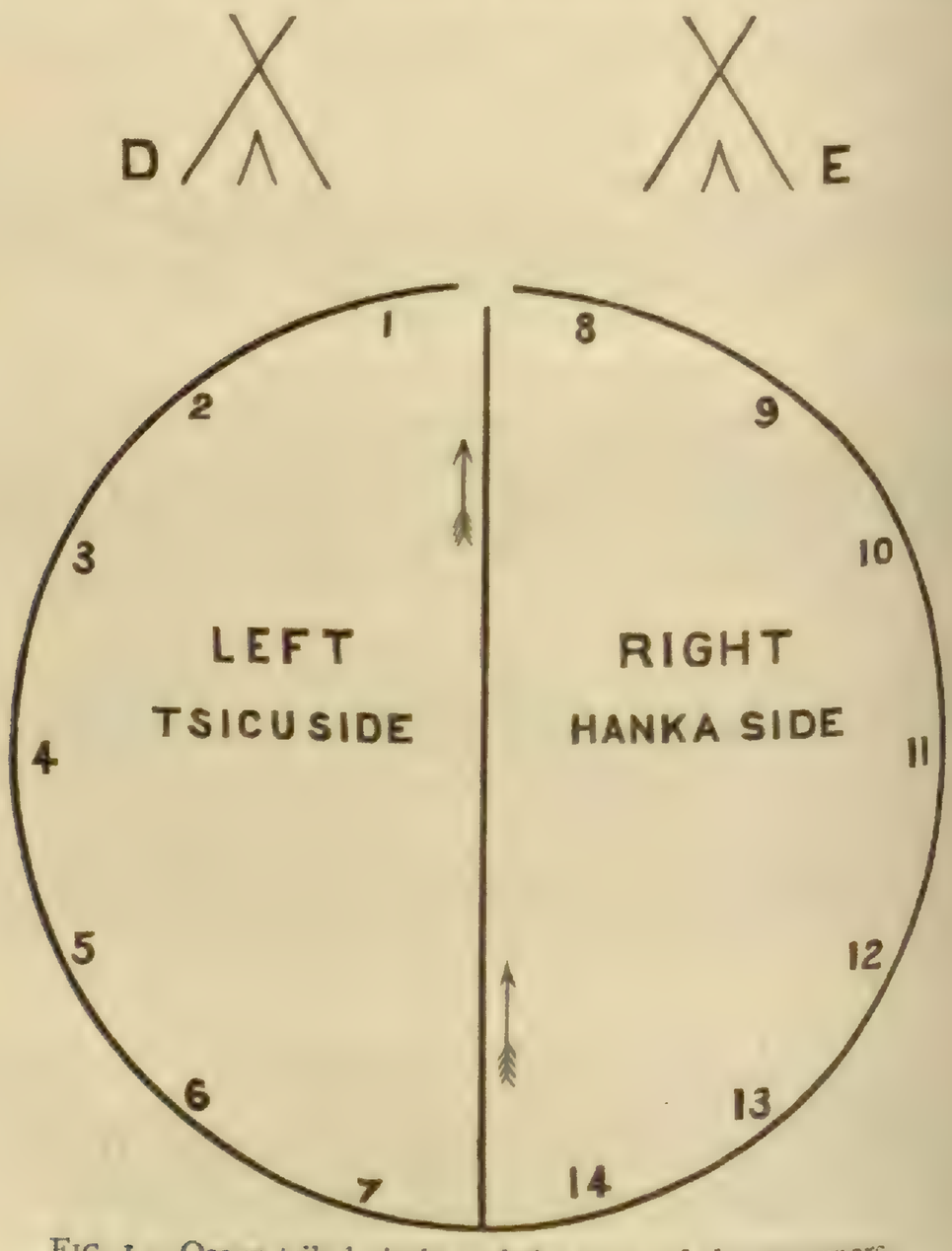

FIG. 1.—Osage tribal circle and the tents of the mourners.

on this side, as the Chee-zhoo peace-makers are on the left): they form a Wa-zha-zhe fire-place. 11. Hañ-ka having wings, an eagle gens. 12. Black bear. 13. Elk. 14. Kansas, pipe-light-

ers, or wind people. All but Nos. 8 and 10 are Hañ-ka fire-places.

The line drawn through the circle denotes the road traveled by the tribe. This forms the boundary between the two half-tribes.

The following accounts of the Osage war customs are necessarily incomplete, being obtained from a member of the principal peace gens. Moreover, there are customs peculiar to each gens, which are not familiar to members of other gentes.

There are three kinds of war parties among the Osages. The first is the large war party, undertaken in the summer. The next the sacred bag war party, in which only a few engage at any season. The third is called "tsi′-ka-kha′," undertaken at any time, being an expedition after the horses and other property of the enemy.

I.—A Large War Party (Tu-ta^{n}′-hü Tan′ka).

When a man on the left side of the tribal circle is mourning for one of his family, he selects a man from the right side of the tribe to mourn with him, and to be the real leader of the expedition. Let us suppose that the first mourner is a Chee-zhoo peace-maker man. He must present the other man, whom we will call a Hañka (in full, Hañka-apart-from-the-rest), with one of his best horses. Then the Chee-zhoo chooses a kettle-bearer for himself, and this kettle-bearer builds a small lodge (*D*, Fig. 1) for his friend. It is on the west side of the village, and is made of two buffalo robes. The door faces the west. A similar lodge (*E*) is built for the Hañka mourner, by his kettle-bearer, on the right side of the circle, and towards the west, as in the figure. Each mourner stays alone in his lodge, seeing no woman.

As the Chee-zhoo is a peace gens, it has no war customs pertaining to it, so the Chee-zhoo mourner has to apply to a man of the first gens, Lock-wearers, to act as his teacher. The Lock-wearers and Buffalo-bull-face people are the soldiers or policemen of the Chee-zhoo peace-makers. Should the mourner fail to obtain a man of the first gens, he must ask one of the second gens, Buffalo-bull-face people, to instruct him. The Hañka mourner must select his teacher from one of the soldier gentes on his side, Elder Osages or Hañka apart from the rest.

Within four days of the time for departure, the mourners return to the village and begin their preparations. The Hañka mourner directs his teacher to select the time and place for

the final ceremonies. Whereupon the teacher goes to one of the heralds (an Elk or Kansas man), telling him to proclaim the news around the village.

All the people who wish to see the ceremonies take a sufficient number of tents and remove to the place outside the village, pitching their tents in a circle. The large tent of the Cheezhoo is put up on the left, at *A*, Fig. 2, and the corresponding tent of the right side is pitched at *B*. The latter is the leading tent when

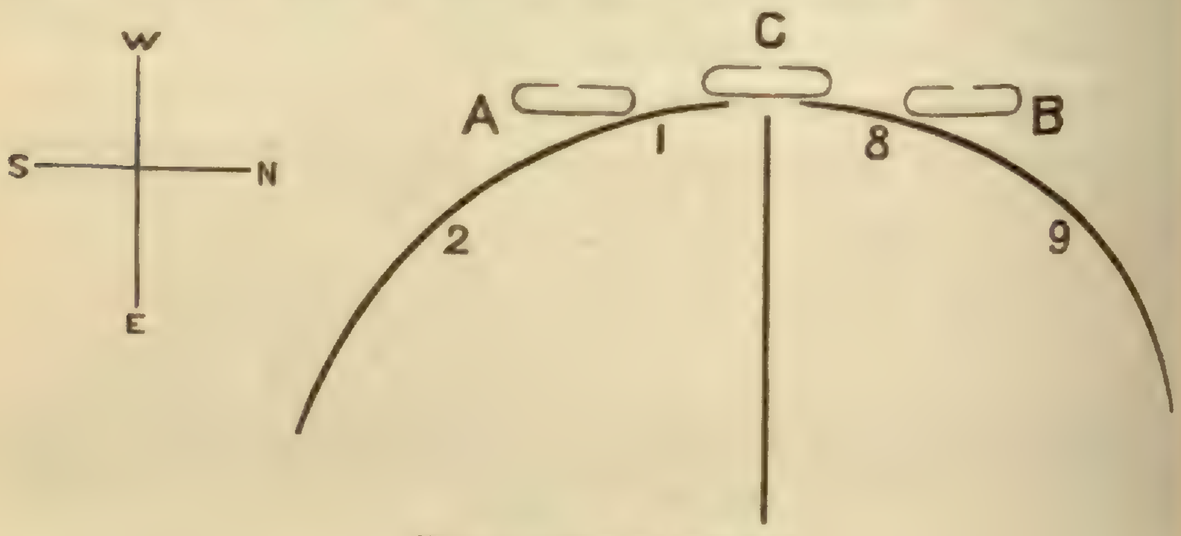

FIG. 2.—Plan of war tent.

the deceased belongs to the left side, and the former is the leading tent when the deceased belongs to the right side of the tribe. The leading side and tent must always be opposite to that to which the deceased belongs. The Cheezhoo peace-maker men, being of the gens of the mourner, lead all the men on their side of the tribe, who assemble at the tent *A*. So the Hañka men lead all the men on their side, who meet at *B*.

Each mourner receives a war pipe and a forked stick on which he can hang the bag in which the pipe is kept. The pipe is an old one handed down from preceding generations. Such pipes are always kept by those men who have taken a degree in the secret order of the tribe. The drum used on this occasion is made by a man of the Sun-carrier gens. Two battle standards are made for each mourner by an old man of the Elder Osage gens (Fig. 3). One on each side has seven feathers, and is reckoned as the superior one; and the other has six. The bottom of each standard terminates in a sharp point, which is used as a spear. When the two teachers ask the Elder Osage man to make the standards, they hand him a new knife, some paint, and all other materials required for them. When he finishes them the knife and the remaining materials belong to him. At the

same time the teachers give him some calico to pay him for his trouble. When the standards are completed, the old man says: "O Hañka and Cheezhoo, as you have paid me, take the standards quickly!" The Cheezhoo teacher takes his in his left hand,

FIG. 3.—Battle standards.

and the Hañka extends the right hand for his standards. Then they lay down the standards before them.

Then the general war tent of the tribe (Figs. 2 and 4) is erected at *C*, facing the west, the place of honor being at the rear, towards the east.

All the principal men of each side, including the head men of the gentes, who are a sort of priests, meet in the war tent, *C*. There the drum beats. At the rear of the tent are seated the principal old men, one for each gens. The two mourners are still outside. By and by the mourners are brought into the tent, in which there is no fire. The two bags containing the war pipes are hung on their necks.

For this occasion two war bags are made of the feathers and skins of war eagles by some of the old men. These bags are now brought into the tent by the teachers, who present them to the mourners. The old men who made the bags now choose two or three men for each mourner, to act as Wa-sha′-pe wa′-shu-

wa'-kdhe, whom we may style lieutenants (though that is hardly the translation). These men drop their blankets and wear nothing but their breech-cloths as they stand in a row with their mourners. The old men who made the bags select a herald for each mourner out of any gens. These stand next to the lieutenants. Each lieutenant and herald receives a war pipe. The Cheezhoo herald receives in his left hand a knife with the handle painted red. The Hañka herald receives in his right hand a hatchet with the handle reddened.

Then the Hañka mourner (*B*) is brought to the front, and is told to select the best men on the Cheezhoo side for standard bearers. He chooses one (*D*), leading him to the front, the latter crying as he goes. To the latter is handed a standard with seven feathers by Cheezhoo's teacher. It is received in the left hand and the man performs a war dance according to his own desire or custom, and then he takes his seat. Then the Cheezhoo mourner is called to the front, being told to select the best man from the Hañka side for standard-bearers. The first that he chooses (*I*) is taken to the front, crying as he goes. Hañka's teacher hands him the other standard with seven feathers, which is received in the right hand. He dances, and sits down. Hañka's mourner selects a man from the opposite side (*F*) to carry the standard with six feathers; and Cheezhoo's mourner chooses a Hañka man (*K*) for a similar office. When the Hañka mourner selects the third man on the Cheezhoo side (*G*), the latter takes the standard from *E*, dances, and returns it to its holder. So when the Cheezhoo mourner selects the third man on the Hañka side (*L*), the latter takes the standard from *I*, dances, and returns it. The fourth standard-bearer on the Cheezhoo side (*H*) takes the standard from *F*, dances, and returns it. And the fourth man on the Hañka side (*M*) takes the standard from *K*, to whom he returns it after dancing.

Then the lieutenants are painted with charcoal. Before this is done, the Black bear people make a fire outside the war tent, placing on it a quantity of small willows which will soon burn. When these are charred, they are broken in small pieces and placed in pans, with a little water in each. Each lieutenant on the Cheezhoo side dips his hands into a pan, rubs them together, and then with his left palm he rubs his face, beginning at the right ear, and going down the cheek, across the mouth and left

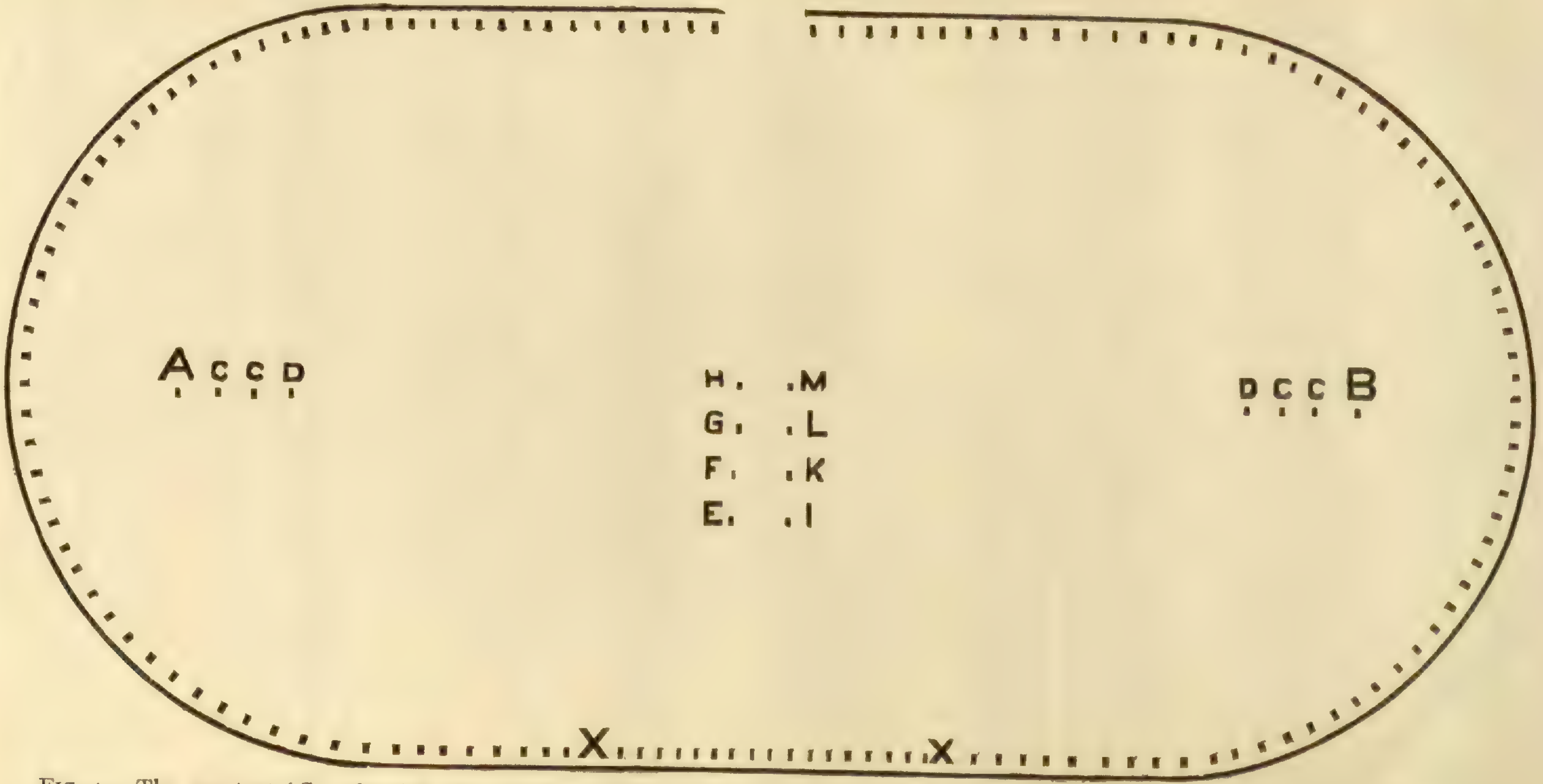

FIG. 4.—The war tent (*C*), showing the positions of the mourners, etc. From *X* to *X*, the twenty-one old men; *A*, the Cheezhoo mourner; *B* The Hañka mourner; *cccc*, the lieutenants; *dd*, the heralds.

cheek to the ear. Next he rubs his right palm across his left shoulder, bringing the mark a little to the front. Rubbing more charcoal on his hands, he places his left palm on his right shoulder, bringing the mark slightly to the front. With his right palm he makes a round mark on the chest, over the depression between the two parts of the sternum.

The lieutenants on the Hañka side proceed in a similar manner, but in reverse order, beginning with the right hand and ending with the left in making the round mark over the breast bone.

These men are now enlisted, and cannot sit down till night comes and the other warriors have lain down. The lieutenants, heralds, and standard-bearers can neither eat nor drink till they receive permission.

After the lieutenants finish painting, the two heralds are ordered to arise, one standing on the Cheezhoo mourner's left, the other on the Hañka mourner's right. They are sent from the tent, being ordered to go about a hundred yards from the village, and then run around it. They start from the west, Cheezhoo's herald going towards the north, and the other man running to the south. When the Cheezhoo man gets due north, and the Hañka is opposite him, the former cries to the latter: "O Hañka, he says that you will cause the spirits of the animals to pass along! He says that you must cause the spirits of the animals to pass along at sunset!" To this the Hañka man replies, "O Cheezhoo, he says that you must cause the spirits of the animals to pass along! He says that you must cause the spirits of the animals to pass along at sunset!" Just before they reach the east, they cry again, Cheezhoo speaking first. When they pass the east the Cheezhoo man goes outside of the other's course, keeping to the left of the latter. When the Cheezhoo reaches the south, and the Hañka is at the north, they cry again; and so when they return to the west. Then the large war tent (*C*) is taken down.

The Hañka mourner tells the Cheezhoo mourner and standard-bearers to collect their warriors, while he and his standard-bearers do likewise on the Hañka side. All the Cheezhoo men of the seven gentes have to prepare for the four days' dances. They also have to furnish a drum. They meet in their large tent (*A*) at the back of which are seated the four standard-bearers (*E*, *F*, *G* and *H*). The man who has the standard with seven feathers (*E*) is the principal one, so he sits on the left of the one with six

feathers (*F*). The standards are held with the feathers facing the west. The rest of the men sit around the tent. Then *E* selects all the young men who are to sit with the party as warriors, and the adult kettle-bearers, who prepare food for them. Of these latter there are from ten to twenty, no fixed number, and they have a separate camp. Next *E* selects about six youths who are fast runners, to act as kettle-bearers who give water to the warriors. The man who cooked for the mourner at the first, and made the small lodge for him, is the leader of the kettle-bearers on his side.

A man of the Sun-carrier gens is requested to make the drum for the party. He is furnished with the requisite implements, and gets a piece of calico as his pay. In the meantime the Hañka standard-bearers are doing similar things, but in a different order. In the Hañka tent (*B*) the man with the seven feather standard (*I*) sits on the right of the other, who has that with six feathers (*K*). No. 3 (*L*) is on the right of *I*, and No. 4 (*M*) is on the left of *K*. The adult kettle-bearers and the kettle-bearers who give water are chosen by the holder of the principal standard (*I*). A Sun-carrier man is hired to make the drum.

Then follows a dance around the village, while the two Sun-carrier men are making the drums. Prior to this dance the men of each party try to get ready and rise to their feet before the others. The mourners, lieutenants and heralds keep at a short distance from the singers and dancers. At each tent (*A* and *B*) a standard is raised. In modern times this is the U. S. flag.

The principal kettle-bearer on each side carries one of the flags, and he is followed by the rest, including the kettle-bearers or servants of both kinds. (See Fig. 5.) After the two parties pass each other, they walk in silence for about fifty yards, when the drums are sounded for another dance. (These drums are probably those which were used at the war tent *C*, as the new drums are not yet finished.) The dance is accompanied by a war song. Then they go silently as before; and so on till they arrive at the rear of the village. They sing and dance as they pass each other the second time; and so on till they return to the tents at the west. Then they have a dance, in which they tell what they expect to do when they meet the enemy. This must not be confounded with the bravery dance, which takes place afterward, according to Red Corn.

After this each mourner or war captain gives to his principal kettle-bearer a horse, which the servant sells to the man who will give the most food for it. The food is brought in and cooked by the adult kettle-bearers. The women are invited to a feast, but the men eat none of the food. Each woman brings a bowl of flour, coffee, etc. The kettle-bearers run to meet them, take the food and place it in a heap. At the end of the feast the empty bowls are handed to their owners. The food brought by the women is cooked and the men have their feast. Should the supply be insufficient another horse is sold for food, the women are invited to another feast, and they give more food in return for the

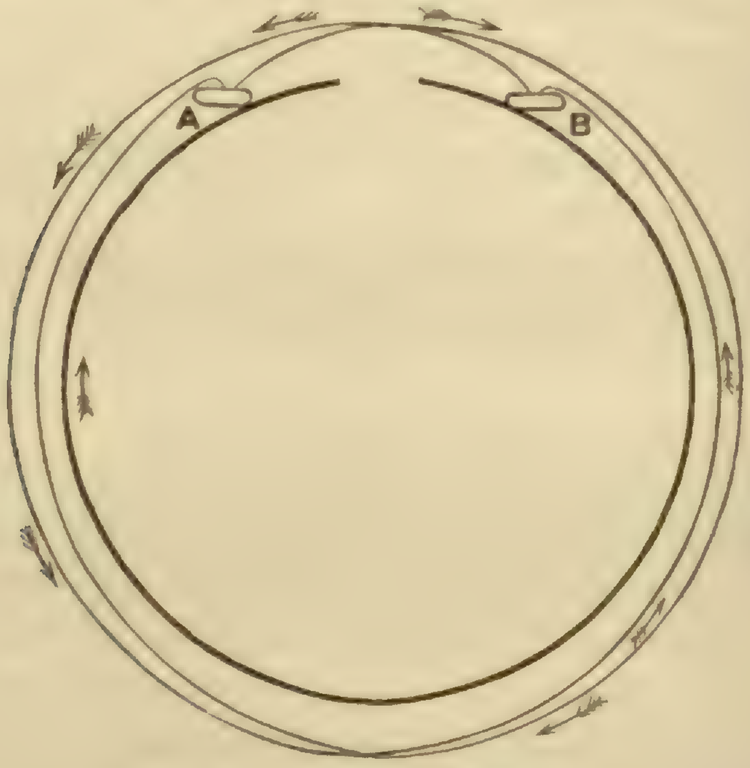

FIG. 5.—Dance around the Village.

men to eat. The dance is continued through the day, till about half an hour before sunset.

Then they dance the U-dhu′-ta wa-tsi^{n}′ or *circle dance*, in which the Cheezhoo men dance from the west to the north, thence to the east and south, and round to the west again. The men on the other side go in the opposite direction. In this dance the first standard-bearer on the Hañka side tells one of his exploits in a song, as he dances. He is followed by the leading Cheezhoo standard-bearer. The principal Hañka standard-bearer sings and dances again, and is followed, as before, by the first Cheezhoo standard-bearer. So the two sing and dance in turn till they have sung about twelve songs. A whoop is made and the men march a short distance to perform the dance called the bra-

very dance. They meet in front of the large Hañka tent (*B*), and the flag is hoisted (Fig. 6). All sit out of doors, forming a figure like a capital U, at the base of which are the standard-bearers. Next to them sit the warriors, and the kettle-bearers sit at the ends. The leading Hañka standard bearer (*I*) arises, sings and dances a little to the west, and then back to his place, when he resumes his seat. He is followed by the first Cheezhoo standard-bearer (*E*), after whom dances the second Hañka standard-bearer (*K*), who is succeeded by the Cheezhoo of the same rank (*F*). Next come the third Hañka and Cheezhoo men (*L* and *G*), then the fourth pair (*M* and *H*). Then the warriors dance in like manner. When they have finished the kettle-bearers may dance if they desire.

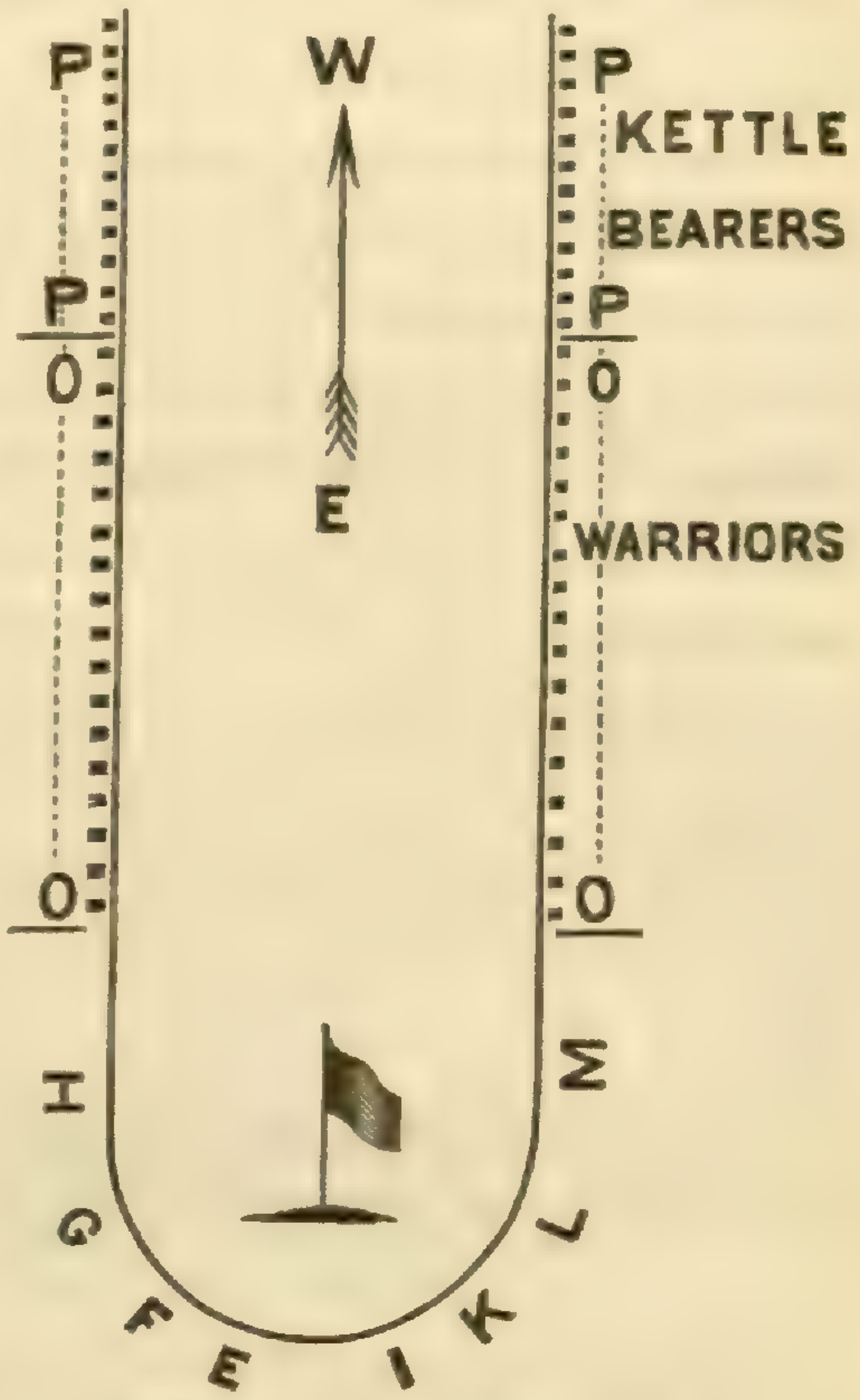

FIG. 6.—Bravery dance.

This ends the dances for the first day. Then the heralds make another circuit of the village, starting from their respective tents, *A* and *B*. After this the war captains, warriors and servants sit and rest, smoking and talking till it is time to sleep. The principal standard-bearer on each side (*E*, *I*) calls his war captain, telling him that on the morrow, just at daybreak, they must make the mysterious charcoal. Then the Hañka standard-bearer, *I*, tells his captain to inform the men that they can lie down. So one of the Hañka lieutenants cries over to those in the other camp: "Halloo, lieutenants!" One of the Cheezhoo lieutenants replies, "What is it?" The Hañka man says, "Ho! ye adult kettle-bearers, ye young kettle-bearers and ye standard-bearers! it is said that you shall sleep!" The Cheezhoo replies, "O, grandfather, it is well!" Then he addresses the men on his own side, but in a loud voice, so that those on the other side may hear, too: "Ho, O comrades, standard-bearers! Ho, O comrades, ye adult kettle-bearers! Ho, O comrades, ye young kettle-bearers! it is said that ye shall sleep!" Then the Hañka lieutenant calls again, "Ho, O lieutenant!" The Cheezhoo says, "What is the matter?"

The Hañka says, "O war captains and ye lieutenants! it is said, O comrades, that you shall sleep!" The Cheezhoo replies, "It is well, O grandfather!" Then he addresses the mourners and lieutenants on both sides, "Ho, O comrades, ye war captains! Ho O comrades, ye lieutenants! it is said that ye shall sleep!" Then the Hañka cries again, "Ho, O lieutenant!" The Cheezhoo says, "O my grandchild! to-morrow you shall cause them, it is said, to attend to their duties." The Cheezhoo replies, "O grandfather, it is well!" Then he says to all, "O comrades, to-morrow I will cause you to attend to your duties!" This ends the ceremonies and proclamations for the night.

On the second day the Cheezhoo men precede the Hañka men in every rite, one of their number being the master of ceremonies for the day. On the previous evening members of the Dhu'-khe sub-gens of the Buffalo-bull gens brought in bunches of dried willow, which were laid out of sight by some of the men on the Hañka side. Before daylight, on the second day, all the men arise, and the men of the Night gens (who are a sort of bear people) set the willows afire; while the fire burns, long prayers are made by the men of the Night and Elder Osage gentes. At the end of a song they see who can get some of the fire. In the struggle which ensues the pieces of willow are crushed to pieces. This act has a special name. What charcoal each one gets is saved till the return to camp. The charcoal symbolizes the enemy. On their return to camp each warrior goes to his place and mixes the sacred charcoal with ordinary charcoal, after which he paints himself. Those who desire go and sing around the village. After breakfast they dance around the village all the morning, as on the first day. Then they have another feast at about noon. They dance the circle and bravery dances, as on the preceding day. At night, just before retiring, one of the Cheezhoo lieutenants calls to those on the other side. A Hañka lieutenant replies, "O my grandchild! what is the matter?" Then the Cheezhoo says what the Hañka did on the previous night, and the Hañka speaks the words used on that occasion by the Cheezhoo.

On the third day the Hañka men precede the Cheezhoo men in every rite, as they did on the first day, and one of their number acts as the officer of the day. The sacred bags of a large war party are brought in, one by a Wa-zha-zhe or Osage man for

the Hañka side, and one by a member of the Lock-wearer gens for the Cheezhoo mourner.

They dance as on the preceding days. The Hañka mourner tells the Cheezhoo that on the morrow they will take the first step.

On the fourth day the Cheezhoo men lead in every rite, as they did on the second day. Two narrow strips of buffalo hide are prepared by an old woman of a Buffalo gens on the Hañka side of the circle. These strips are placed side by side on the ground, and about two feet apart. The Cheezhoo men place their left feet on the rear one, and their right feet on the front one. The Hañka men have their right feet on the rear one and advance with their left feet on the front one. This is the first step taken on the war path.

The warriors now mount their horses, forming in two columns, in each of which they go two abreast. The standard-bearers ride in advance. The Cheezhoo column goes once around the village, in the usual course from the west to the north, thence by the east and south to the west again. The Hañka column proceeds in the opposite direction. They approach one another again at the west, and depart westward in parallel columns (Fig. 7). Their course on the war path is supposed to be towards the west. When they have gone a certain distance from the village a member of the Dhu-khe sub-gens of the Buffalo bull gens is taken to the front, where he performs a rite. At its conclusion the march is resumed, and they continue on their journey for about four days, at the end of which period a small tent is erected for each captain or mourner, the door facing the west. Each eagle is removed from the sacred bag and placed on top of the small tent (on its proper side), facing the west. Each captain goes through his tent from east to west, knocking down the tent, and causing the eagle to fall to the ground. The eagle is restored to its bag. Then all the warriors except the captains,

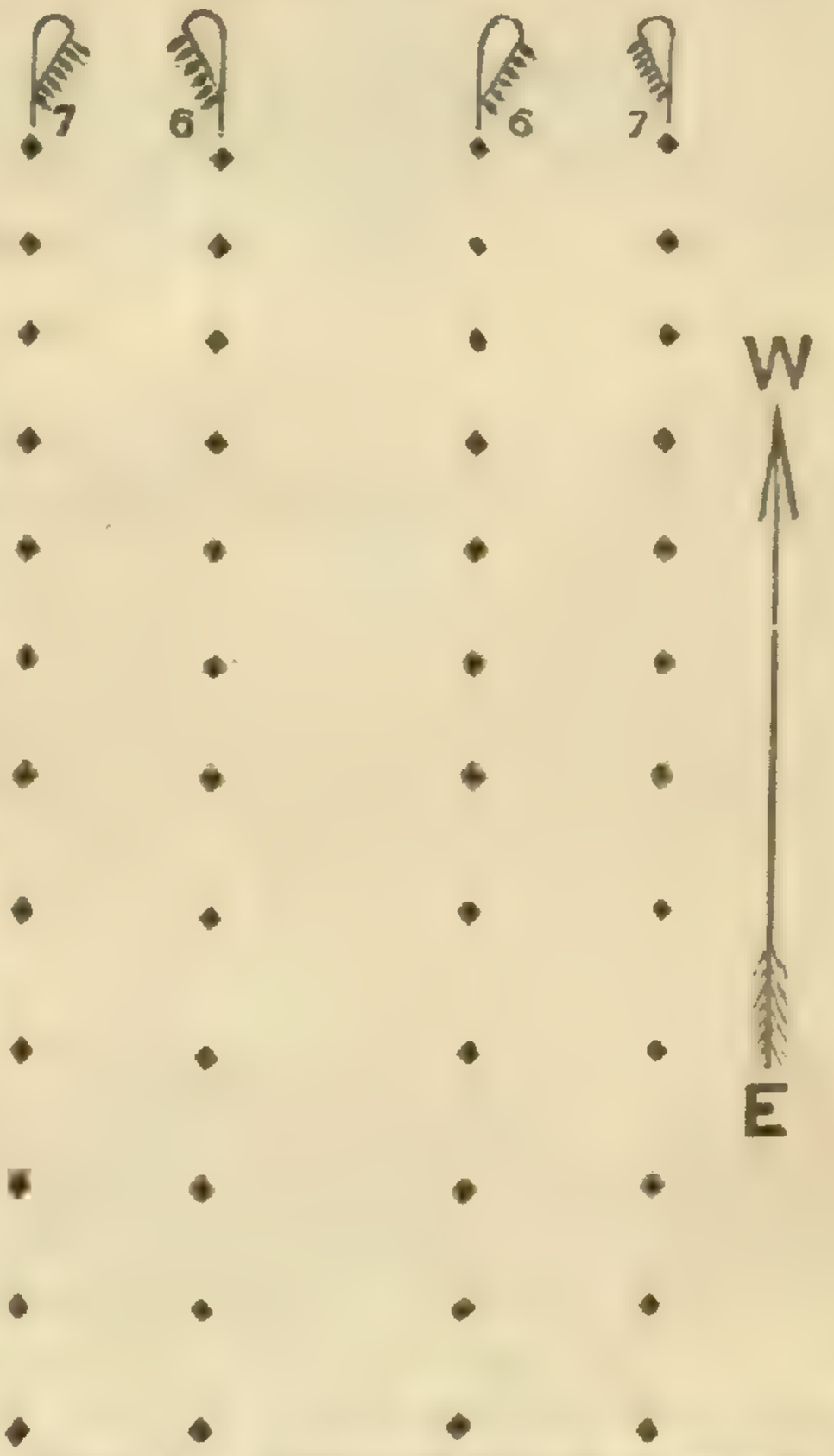

FIG. 7.—Order of march towards home.

lieutenants and heralds can swim and wash their faces. They resume their march, and by and by they meet a foe whom they attack. Let us suppose that they kill him. The first man who strikes him gets the first honor, and the second honor is given to the next who gives a blow. The scalp is handed to the Hañka captain, who gives it to the Cheezhoo captain, saying, "Here is that for which you employed me." The corpse is laid with the head to the east. The Hañka captain makes a hole on the right side of the chest into which is thrust the standard with seven feathers of the Hañka men, the feathers pointing to the west. The Cheezhoo makes a hole on the left side of the corpse into which is stuck the principal Cheezhoo standard. The second Hañka standard-bearer places his standard, with six feathers, between the right arm and the chest; and the second Cheezhoo standard-bearer puts his between the left arm and the side.

Should they lose one of their own men at this place, they set up the body against a tree or bank, using most of their paint in painting him all over. They break four arrows which they lay by him, and they leave some paint there. After mourning over their own dead, they will mourn for the foe just as if he was a friend. At certain intervals (answering to every two or three hours, as we reckon time), the standard-bearers tell the captains to command the warriors to mourn. Before they reach home all the trophies, including the scalps, are placed on a pole, at which they charge, firing four times at it.[1]

When they have lost one of their party they neither eat nor drink till they have poured out food and water for the dead. When they come to a post oak they strip it of the bark for about five feet from the ground; they paint the tree red, break four arrows and leave them by the tree with some paint.

When they approach the village, they cannot enter it if they have lost any of their party; but they must stop, in that case, about one or two hundred yards from it. The principal man of

[1] A similar custom is practiced by the Dakotas when they cut down the pole for the sun dance; and the Omahas and Ponkas charged on the tree ere they cut it down for their sacred pole, more than two hundred years ago. The Omahas said that their pole, on that occasion, represented an enemy, and a scalp was put on its head in accordance with that notion. A race for a tree also occurs when the Omaha young men go to cut down one for the dance after the thanksgiving for success in the buffalo hunt. Further investigation of this custom may reveal other interesting facts.

the Kansas gens knows what is meant. He puts on a robe made of bear or buffalo skin, and advances toward the party, with his kettle-bearer, till he can hear what they say. He begins the conversation by asking them what is the cause of their halt. Then he tell them the news from the village. After this he approaches the warriors, going around them, and performing a rite, first at the north, then at the west, south and east. Next he addresses the Hañka captain, then the Cheezhoo captain, telling whether they can enter the village.

Having gained his consent, they leave all their blankets and other clothing, as the pay of the old man and his servant. But they retain their weapons. They are met by some of the people, who give them other garments. Then the warriors separate. The tents *A* and *B* are thrown down, and the war tent, *C*, is set up again at the west.

The final ceremonies are the scalp dance, captive dance (?),[1] dance in which they take the standards, and the trial over the sacred bags. One of the captains may select any one of the three dances to the exclusion of the others, or he may have two without the standard dance; but the trial over the sacred bag is never omitted.

The scalp dance.—Previous to this dance, the captain of one side gives a horse to his principal kettle-bearer, who sells it for the food needed at the feast which precedes the dance. The standard-bearers dressed in their finest attire, notify all the women in the village: "We wish you to come and dance this afternoon." Then the two captains go around the village, saying, "Ho, my little sisters! my comrades! it is said you must pity me!" Each captain walks around the village according to the side of the circle in which he camps, and each woman in dancing remembers this rule.

After the women have been called by the captains, the former strip to the waist, covering their bosoms with pieces of cloth or calico. They pretend to be men, decorating themselves with feathers, paint, etc. They are led by one who carries the scalp on its pole. She is chosen for that purpose by one of the captains. Some women carry bows, others take arrows, some have war pipes, and some carry peace pipes. The drummers sit in a small circle around the pole. A great warrior arises and tells of his ex-

[1] **Takdhe watsi^{n}, in Osage. Its translation is doubtful.**

ploits. Then the drum beats, and the women dance. All start together, the women of the Cheezhoo gentes moving in one direction, and those of the Hañka gentes in the other, around the pole. The successful warriors who are mounted, come in their war dress, and gallop around the pole, close to the women, telling of their deeds. This dance is continued for about half an hour. The trial or ordeal of the sacred bags must follow on the next day, unless a captain wishes to have the captive dance, in which event it follows.

The captive dance.—A war captain gives another horse to his chief kettle-bearer, who sells it for the food required for feasting the guests before the dance. The standard-bearers and captains go around the village, as on the preceding day, and the women come, as before. The drummers sit around the pole. The dancers are led by two men abreast. These used to be men that had gone to war afoot. They are followed by two women, then two men, then two women; and so on. Those who went to war mounted come to the dance on their horses. One of the principal men tells his story first; and the horsemen tell their deeds as they gallop around the dancers. The dance lasts for about half an hour. But if the captain prefers, he may substitute the standard dance for the captive dance. But if the latter is chosen for the second day, and the captain wishes to gain more honor, he gives another horse to his chief kettle-bearer, to be sold for food for the feast that is held before the Standard dance on the third day.

The Standard dance.—The standards are made like those used at the beginning of the expedition, and they are given to the standard-bearers, who dance around the village, two abreast, all going in the same direction, followed by the other warriors. Having gone around the village, they assemble at a short distance from it and have the circle dance and bravery dance, as at the first. This ends the dancing for that day.

The Trial over the sacred bags.—The old men assemble in the war tent, *C*. The sacred bags are brought in to test the warriors, who are watched very closely by the old men. All the old men who have been distinguished in war are painted with the decorations of their respective gentes. That of the Cheezhoo peace-maker gens is as follows: The face is first whitened all over with clay; then a red spot is made on the forehead, and the lower part of the face is reddened. With his fingers, the man scrapes off the white clay,

forming the dark figures by letting the natural color of the face show through. (See Fig. 8.)

Each warrior has four sticks about six inches long, to be laid in succession on the sacred bag. The warriors are taken in the following order: First, the captains, next the lieutenants; then the heralds; after whom is the man who struck the first blow; then he who hit the second blow; and so on.

As each captain lays his first stick on the bag, he says, "Ho, O grandfather! I lay this down on you because I am one who has killed a man." On laying down the second, he says, "Ho,

FIG. 8.—Decoration of the Tsicu Wactake or Cheezhoo peace-maker gens.

O grandfather! I wish to be fortunate in stealing horses! I also wish our children to be as fortunate as we!" When he puts down the third, he says, "Ho, O grandfather! I wish to raise a domestic animal. I wish to succeed in bringing it to maturity." By this he means a son. The prayer when the last stick is laid down is as follows: "Ho, O grandfather! May we continue a people without sustaining any injuries!"

Similar petitions are made by the lieutenants and heralds. He who gave the first blow says, as he lays down the first stick, "Ho, O grandfather! I lay down this on you as one who has caused another to stun a foe!" The rest of his petitions are those of the

captains and other men. He who struck the second blow, says as follows, on laying down his first stick: "Ho, O grandfather! I place this on you because I was the next one to strike and stun a man!" The other petitions follow, as given above. The first petition of each of the remaining warriors is as follows: "Ho, O grandfather! I lay this on you as a token that I have aided in overcoming the foe! (A provisional translation, as the writer is uncertain as to the exact rendering of "wa-yü-khpe," which, judging from the meaning of the root *khpa* and *khpe* in cognate languages, implies *pulling down a foe.*)

At the conclusion of this trial, the warriors rub the paint off, and wash their faces, thus ending the war party.

II. Sacred Bag War Party.

A man mourns alone, putting mud on his face. He comes into the village, and selects a man for his first kettle-bearer, who builds for him a small lodge apart from the village. The mourner retires to this lodge, and keeps away from the women. He sends his servant, the kettle-bearer, for two men, one on the Hañka side of the tribe, the other on the Cheezhoo side, to act as standard-bearers. When they come to him, he informs them whither he wishes to go, and for what purpose. The three depart to invite the warriors. Those who are willing can join the party. The mourner has a pipe and tobacco, also a sacred bag made of the skin and feathers of a bird, given him by his teacher, one of the old men belonging to the secret order.

The servant cleans out the pipe bowl, which is filled by the mourner. The latter hands the pipe around the circle of guests, beginning with two standard-bearers. Last of all the mourner smokes. As he hands the pipe to each man, he says. "Grandfather, I ask an animal of you." The reply is, "Captain, you shall have your desire."

All march a short distance from the village. A small fire is made. The teacher performs a ceremony over the mourner, and then makes him take the first step on the war path, as has been shown in the account of a large war party. Then the old teacher departs to the village. The warriors march on. When they meet a foe, he who strikes him has the first honor, the second who hits him, cuts off his head. The honor of killing him belongs to the captain or mourner, whether he is the actual slayer

or not; and the whole scalp is his. When they turn back, they hasten homeward. Before they reach home, the scalp and other trophies are fastened to a pole, charged on and shot at four times.

When the warriors get near the village, they use charcoal for painting their faces and the scalp. The young kettle-bearers make this charcoal, using willow if they can find any. Then follow the ceremonies accompanying the cutting off the under skin of the scalp. The captain stands facing the east, and if he is a member of a gens on the Cheezhoo or left side of the tribe, he holds a knife in his left hand. If he belongs to a gens on the Hañka side, he holds the knife in his other hand. Holding the scalp in

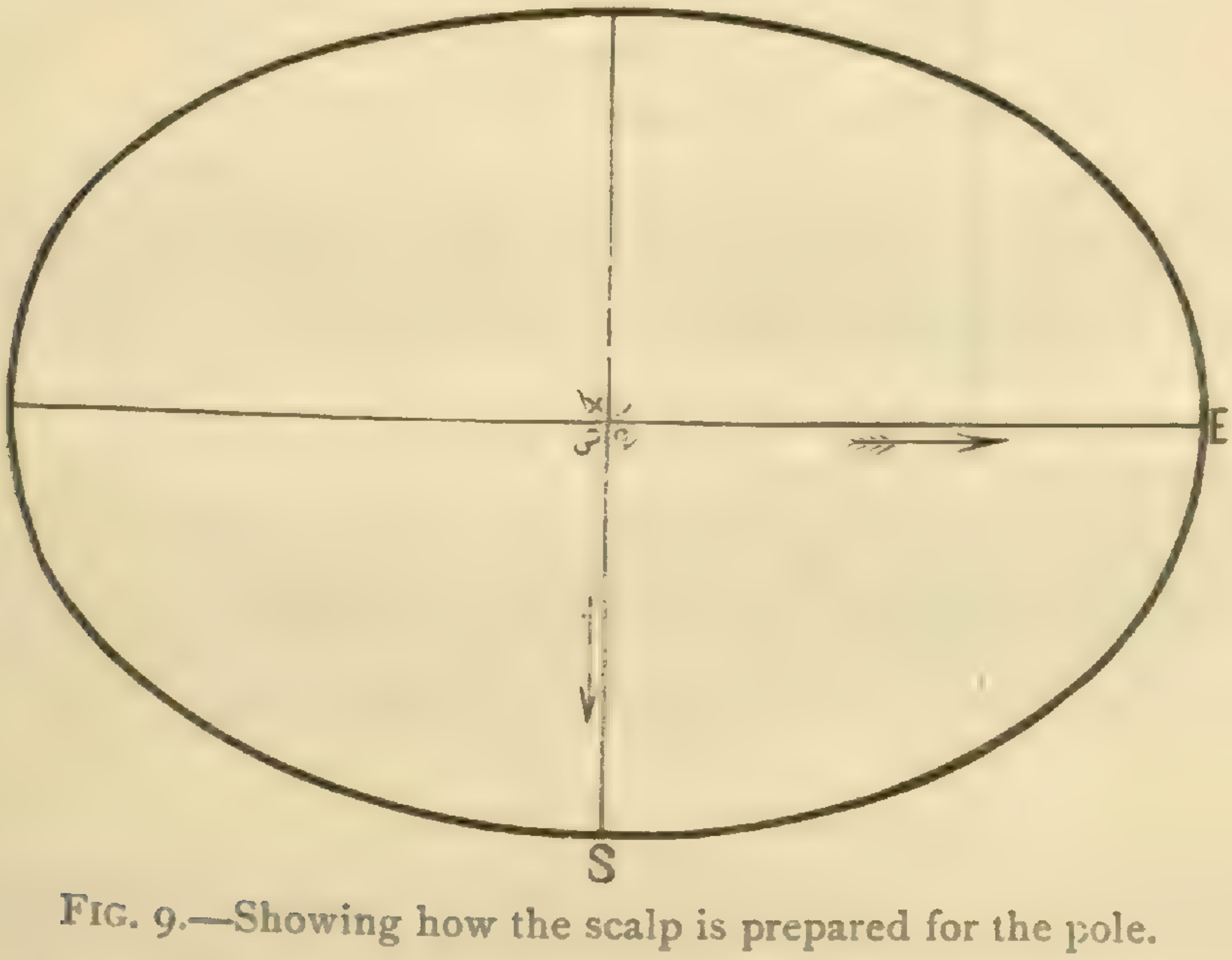

FIG. 9.—Showing how the scalp is prepared for the pole.

one hand, with the other he places the blade across it, with the point towards the south. (Fig. 9.) Then he turns it with the point toward the east. Next, with the blade resting on the scalp, the point to the south, he moves the knife backward and forward four times, cutting deeper into the scalp on each occasion. Then he makes four similar cuts, but with the point to the east. After this, the flat part of the blade being on the scalp, its edge is put against one of the four corners made by the previous incisions (1, 2, 3 and 4), beginning with No. 1. He cuts under each corner four times, singing a sacred song each time that he changes the position of the knife. All of the under skin is cut loose by this time, and is thrown away. The scalp is stretched and fastened to a bow, which is bent and formed into a hoop. This hoop is tied

to a pole that is carried by the principal kettle-bearer. (See Fig. 10.)

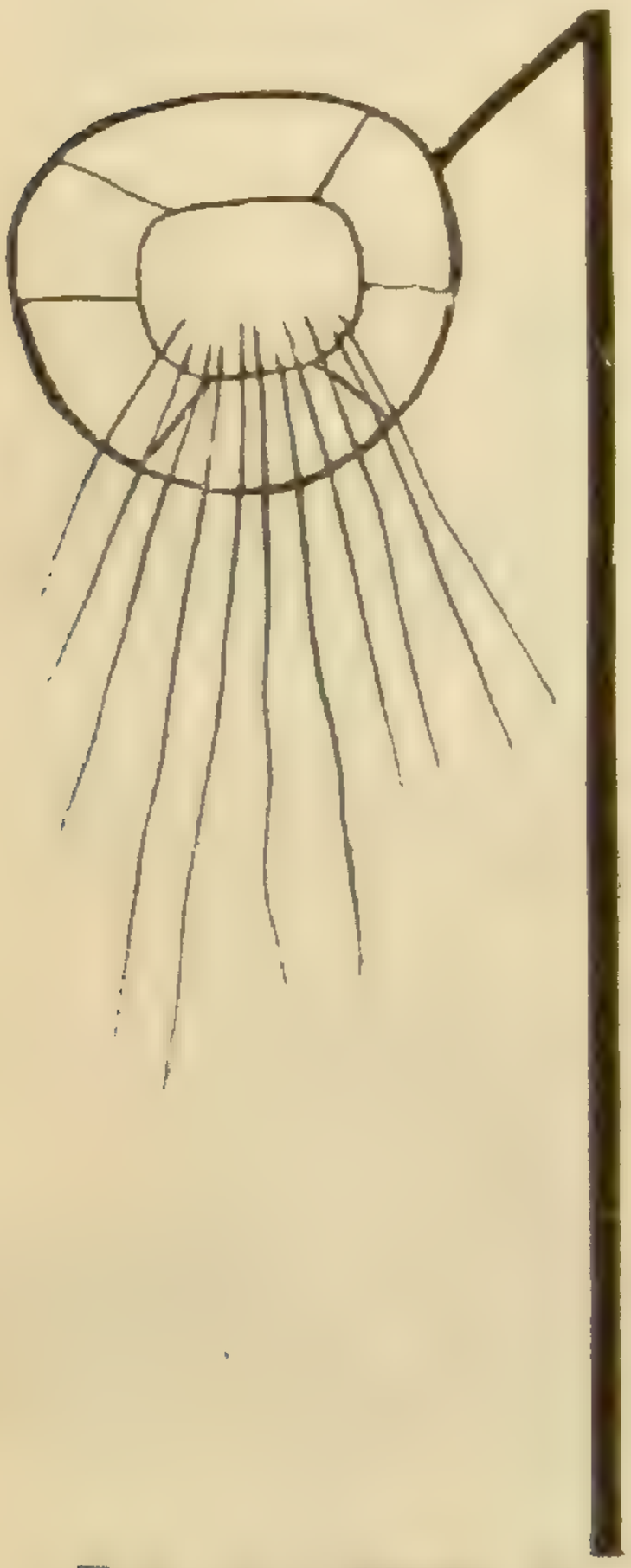

FIG. 10.—Mode of mounting a scalp.

On reaching the village, they charge around it, shouting and giving the war whoop. Such of the old men as have been warriors go out to meet them, asking who was the first to strike a blow, who cut off the head, etc. On learning these things, those old men who struck foes when they were younger, say in a loud voice, that all the people may hear, "As I struck a foe, such a one (naming him) has done so too!" Others say: "As I cut off the head of a foe, such a one (naming him) has done so too!" Then follows a feast, after which comes the dances which have been described.

During the trial of the warriors over the sacred bag, the affirmations and petitions resemble those used by the members of a large war party, with only one exception. The man who cut off the head of a foe says, when he lays down his first stick, "Ho, O grandfather! I lay this down on you as one who has broken off a head."

III. HORSE-STEALING EXPEDITION.

This can be undertaken at any season. There are as many captains as may wish to join the party. Each one of them is a mourner for dead kindred, or for stolen property.

When men wish to steal horses from the enemy, they paint their faces with charcoal.

On such an expedition the customs resemble those of the other parties.

GENERAL REMARKS, APPLICABLE TO ANY WAR PARTY.

Before attacking the foe, the warriors paint themselves anew. This is the "death paint." If any man dies with this paint on him, the survivors do not put on him any other paint.

All the gentes on the Cheezhoo side use "fire paint," which is red, applying it with the left hand all over the face. They use prayers about the fire, saying, "As the fire has no mercy, so should we have none." They put mud on the cheek, below the left eye, and as wide as two or three fingers. On the

Hañka side, they put the mud on the right cheek below the eye. This is the young buffalo-bull decoration. With reference to it, a man says, "My little grandfather (the young buffalo-bull) is always dangerous as he makes an attempt. Very close do I stand, ready to go to the attack!" The horse is painted with some of the mud on the left cheek, shoulder and thigh, if his rider belongs to the Cheezhoo side, but the mud is put on the right cheek, shoulder and thigh of a horse belonging to a warrior on the Hañka side.

Some warriors, who act like a black bear, paint with charcoal alone. (The tradition of the black bear people is, that they brought down fire from one of the upper worlds.)

Some paint in the wind style, some in the lightning style, and others in the panther or catamount style.

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NOTES ON SOME APPARENTLY UNDESCRIBED INFUSORIA FROM PUTRID WATERS.

BY DR. ALFRED C. STOKES.

FROM a dead rat which had been lying exposed to the weather for an unknown period, but long enough to have had most of the abdominal soft parts destroyed, the tail was taken and placed to macerate in ordinary river water as supplied the town by hydrant. By the third day the infusion teemed with minute life, an apparently undescribed Heteromita, which at first glance was mistaken for *H. caudata* Duj., being particularly abundant. A careful examination, however, discovered so many essential points of divergence between it and known forms that it seems to demand recognition as a presumably new species, under the name of *Heteromita putrina* (Figs. 1 and 2).

H. PUTRINA, n. sp.—Body obovate, wider and rounded anteriorly, tapering posteriorly to a somewhat obtuse point; surface smooth, endoplasm enclosing several dark bordered refractive particles; nucleus obscure, apparently centrally placed in the median line; contractile vesicle conspicuous, situated near the right lateral margin of the anterior body half; the vibratile flagellum but slightly exceeding the body in length, the trailing gubernaculum about three times as long as the zoöid, both being of equal size and inserted anteriorly. Length of body $\frac{1}{3000}$ to $\frac{1}{1500}$ inch. Habitat, the putrid water of animal macerations.

Fig. 1. Fig. 2.

Heteromita putrina, n. sp. × 1500.

The creature, when in a healthy or comfortable condition, is very slightly if at all changeable in shape. When about to die it takes a sub-spheroidal form and becomes diffluent, but this stage is at times postponed until the animal has passed a short period as a granular amœba, with a large and conspicuous contractile vesicle, slowly moving by a forward flow of a sarcode wave unaccompanied by the posteriorly located granules. The motion of the Heteromita when swimming is rapid and oscillating, being a forward movement by short zig-zags, the animal at the same time rotating on its longitudinal axis.

The anterior vibratile flagellum is ordinarily extremely difficult to detect. The zoöid, when attached, rests at the extremity of its anchoring flagellum, and when viewed dorsally the vibrating lash is visible for only the very short distance between its origin and the point where it curves to pass beneath the lower or ventral surface (as in Fig. 1), this part being flexible but apparently not vibratile. Even when in a favorable position for its own demonstration, the rapidly-moving filament becomes visible only after careful manipulation of the mirror, or after the infusorium has been killed by iodine or osmic acid. Small particles are not affected by its motion until they have floated past the anterior margin of the body, sometimes almost in contact with the surface, when they fall into the stream and are dashed upward, at times performing a complete circuit around the animal to the starting point. If solid food is taken, which I doubt, it must enter through the ventral surface. No solid particle has been seen to pass into the endoplasm, although I have tried to feed the creatures with indigo, and have had the same individuals in a growing-slide for four full days surrounded by myriads of bacteria.

The contractile vesicle pulsates quickly and sharply once every nine seconds. The only method of reproduction observed is by longitudinal fission. The species here referred to is remarkable for its stability of form and for the position of its tractellum or vibrating flagellum, the latter peculiarity having been recorded for no other member of the genus.

In the same animal maceration, as the Heteromitæ were disappearing, many ciliated infusoria were developed, which, according to the latest schemes of classification, can be relegated to the genus Tillina only, although, so far as external contour is concerned, the resemblance is remote. This difference of form, how-

ever, in connection with certain points of structure, compels its addition to the rapidly increasing list of new American species, while the possession of a pharynx from which spring rows of vibratile cilia, at once forces its admission into the above-mentioned genus.

The likeness of the hitherto single known species, *Tillina magna* Grüber, to Colpoda, has been remarked by its discoverer, but the resemblance between the latter and the form here referred to as *Tillina saprophila*, n. sp., is even more conspicuous than with the type, and would necessarily place it in the genus Colpoda were not the pharyngeal series of cilia present. These cilia are apparently larger but much shorter than those of the general cuticular surface, which are long and very fine. They are with difficulty separately resolved by the objective, unless the infusorium is in a weakened or dying condition; otherwise their motion is incessant, and they themselves become visible only through their effect. They depend from the entire internal surface of the membranous pharynx, projecting slightly, if at all, beyond the oral aperture. The cilia of the general surface are extremely fine and, like those in the pharynx, can be satisfactorily distinguished only when the animal is quiescent, those situated anteriorly then showing themselves to be somewhat the largest. The body is grooved obliquely, the striations being especially distinct on the anterior body half. The circular oral aperture is placed in the center of the ventral surface and, as the infusorium is swimming at ease, appears to be lateral. It is followed by the short membranous pharynx curving toward the posterior extremity of the zoöid and bearing the vibratile series already referred to. The endoplasm, usually colorless, encloses several linear straight or slightly curved dark-bordered bodies, and numerous small corpuscles which at times render the body semi-opaque. The nucleus is large and situated near the center of the dorsal region, commonly opposite, occasionally slightly in advance of the pharynx and oral aperture. The contractile vesicles increase in numbers with the creature's age. In early youth the pulsating vacuole is single and postero-terminal; when the Tillina is mature, or nearly so, two, three or even four, posteriorly placed, are not uncommon. When single, pulsations take place about four times a minute.

Reproduction is accomplished by encystment followed by spore formation and by fission into two or more zoöids, the young in

the latter event differing in form so conspicuously from the mature animal that, before the life-history had been traced, they were mistaken for another species and described as such in manuscript. The act is performed without immediate conjugation; whether in the instances observed there had been a remote union, I of course do not know.

Individuals have several times been so accommodating as to enter the field of the objective just before the beginning of the first stage in this reproductive act, thus affording me an opportunity to follow the changes with ease. The body is soft and flexible, but, except immediately prior to encystment, is not changeable in shape. At that time, however, the animal assumes a spherical form, and prepares a cyst so delicate and transparent that ordinarily it is invisible after its evacuation; but occasionally it collapses as an indescribable exuvium containing several bright bubble-like spots, and becomes for a very short time slightly

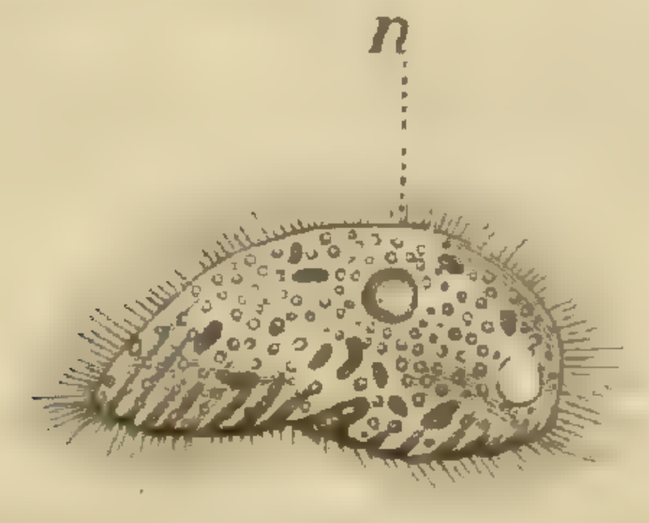

Fig. 3.

Fig. 4.

Tillina saprophila, n. sp. FIG. 3.—Immature form, × 960. FIG. 4.—Mature infusorium, × 750.

amœboid. Fission is accomplished within this sac, and I have in one or two instances observed a binary division without the formation of an enclosing membrane; but in every case it seems that the divided surfaces become the ventral. The process, at least when four zoöids are the result, consumes about two hours from the assumption of the spherical form. The young force their way from the cyst through a small opening visible only in its effect upon the shape of the emerging creatures. A small knob-like projection first appears, and as the animal urges itself through the aperture, a narrow and sharply defined constriction passes successively over the whole length of the body, each of the little animals emerging through the same opening. The young and the old differ, as shown in lateral view in Figs. 3 and 4, the latter being the mature form, in which the dorsal surface, as seen in profile, is much more strongly and evenly convex, and the ventral more flattened, than in Fig 3. In the infusion, forms intermediate

in shape and size are abundant. The length of the zoöid immediately after emergence is $\frac{1}{1000}$ inch, at maturity, $\frac{1}{750}$ inch.

The species seems to be not very susceptible to the deoxygenation of the water, thriving and multiplying where more sensitive infusoria would soon die. But when the supply of oxygen becomes too limited for even its small demands, the second form of reproduction, that of sporular subdivision of the entire body takes place. The zoöid assumes a spherical shape as before, but now prepares a distinct and substantial cyst in which the subdivision is accomplished. I have witnessed the formation of these cysts in very many instances, the completion of the process once only. The cyst wall was then suddenly ruptured and the motionless and finely-divided contents thrown out by the collapsing sac, but to my regret were almost immediately lost amid the surrounding clouds of bacteria.

The movement of the infusorium when first placed on the slide, is rapid and erratic, with rotation on the longitudinal axis; when quieted it is irregularly forward, or in wide circles, usually with one or the other lateral surface downward, thus placing the oral aperture, as already mentioned, apparently upon the side. The following may be taken as a description:

TILLINA SAPROPHILA, n. sp.—Body flexible, obliquely grooved, subreniform or bean-shaped in profile, length once and one-half to twice the width; when viewed dorsally, ovate, wider and somewhat inflated posteriorly, tapering and pointed anteriorly; size and dorsal convexity increasing, the ventral concavity lessening with age, thus giving the mature animal an almost semicircular outline when seen laterally; cuticular surface entirely ciliate, the cilia somewhat larger anteriorly; oral aperture circular, placed centrally in the ventral surface and followed by a short, recurved, membranous pharynx entirely ciliate within; endoplasm enclosing colorless corpuscles and dark-bordered linear bodies; nucleus spherical, dorso-central; contractile vesicles several or single, posteriorly situated; anal aperture not observed. Length of body, $\frac{1}{1000}$ to $\frac{1}{750}$ inch. Habitat, the putrid liquid of animal macerations made with water from the Delaware river.

This species conspicuously differs from *Tillina magna* not only in form and size but in the possession, by the latter, of a posteriorly-developed lobate process, an elongate-ovate anteriorly-placed nucleus, a single contractile vesicle and a larger pharynx.

From an animalcule to a Chinaman is a great leap, and one that mother nature would take longer to make than the writer is at present taking. But Charlie Lee is a genial little Chinaman who now keeps a laundry and sleeps on a shelf, who intends, when he returns to the Flowery Kingdom, to have "a big blick house with tlees in flont." He has started a new "craze" in this

town by the introduction of a Chinese narcissus, whose pretty blossoms are brightening many a front window, and perfuming many a room with their delicate fragrance. Charlie's cultivation of the plant is much like our winter culture of the hyacinth, only he thinks it necessary to surround the bulbs with many stones and pebbles, and to bind together the leaves with a strip of red paper, which gives them quite a military aspect. Several of the outer onion-like layers of these bulbs were put to soak, and the result awaited. My pleasure in this result was to be slightly dashed with bitter. The infusion swarmed with what a friend called "heathen dragons," but the dipping-tube occasionally brought up a fragment bearing a sedentary collar-monad, a Monosiga, which, under other circumstances I would have been glad to see. Members of the Choano-Flagellata have become favorites of mine, and I have learned to associate them with especial purity in their surroundings; so to take them from this brownish, mucilaginous and malodorous liquid, was it not the fall that is said to always follow undue pride? This alone, however, would scarcely have upset my equilibrium. There is a little more. The creature was one that had seemed particularly graceful, and I had described it as new in the *American Monthly Microscopical Journal* for Nov., 1883, naming it *Monosiga Woodiæ*, after a friend. How did it get into this undesirable predicament? Had its quiescent germ been clinging to the bulb from China land? Had it been swinging in the air of Trenton, or had it been floating in the water of the Delaware? Who can tell?

With it *Goniomonas truncata* Fres., whose habitat is said to be "fresh water," was present in profusion, its numbers increasing rapidly by longitudinal fission, and a Tillina, differing so markedly from the form in the rat-tail maceration that it must be regarded as a new comer among known infusoria.

The latter Holotrichous creature, represented in Fig. 5, is so peculiar in form that I hardly know how to characterize it except by saying that it is somewhat mitten-shaped, although its resemblance to that ugly hand-protector is rather distant. Neither kidney nor bean ever possessed that posterior enlargement which gives the animal its curious mitten-like contour, and which makes *inflata* a suitable

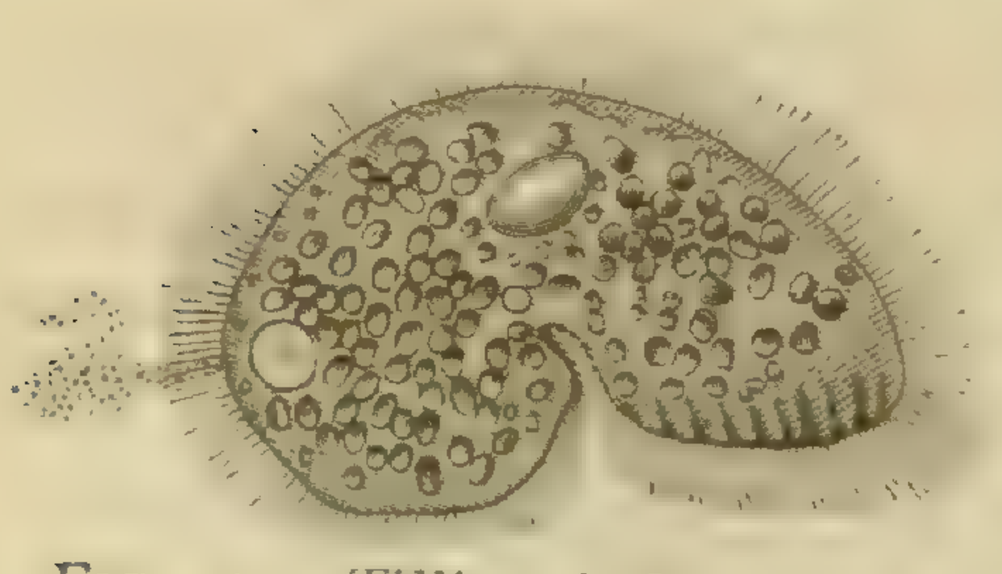

FIG. 5.—*Tillina inflata*, n. sp., × 560.

specific name. When viewed dorsally, consequently in transverse optical section, the body is ovate in outline. In its lateral aspect, as is shown in the figure, it exhibits a superficial differentiation into an anterior narrower body-half and a rounded, very conspicuously widened and inflated posterior portion. When mature it measures $\frac{1}{486}$ inch in length, $\frac{1}{750}$ in. at the widest part of the posterior body half, and $\frac{1}{1000}$ in. at the greatest width of the anterior portion.

The surface is obliquely grooved, apparently in two directions, this double striation being much more conspicuous in the young, as is also the case with *Tillina saprophila*. In color it is a deep amber. The tint varies in depth, however, changing with the color of the infusion and, to a certain extent, with age, the young usually being paler than the adults. The granulate endoplasm encloses many large granular corpuscles, seemingly formed of agglomerated food particles, almost as abundant in those just escaped from the cyst as in the older animals. The large ovate nucleus is located above the median line near the center of the dorsum. The single contractile vesicle is situated close to the posterior extremity and to the right. It pulsates, as in the preceding species of the genus, once each fifteen seconds. The anal aperture seems to be rather indifferently placed either above or below the pulsating vacuole. But I may have misinterpreted this, as its appearance is always sudden and unexpected, the animal being in rapid movement at the same time, and the contractile vesicle probably collapsed and invisible. The ovate oral aperture is placed obliquely near the center of the left lateral margin of the ventral surface. The succeeding rather capacious but short and slightly recurved pharynx is entirely ciliated, the cilia being of course shorter, but apparently much coarser, than the long fine vibratile hairs of the cuticular surface. To actually see the individual pharyngeal cilia is no small matter, demanding no slight amount of patience even after the restless creature has been cornered; their seemingly greater size may therefore be illusory both with this and the preceding Tillina, as I have in no instance been able to see them in the recently-killed infusorium, while those of the cuticle are then readily resolved.

Its movements resemble those of *T. saprophila*, the creature floating upon one side, usually the left, when quietly feeding on the bacteria that seem to be a favorite food. When these plants are

abundant they are swept through the pharynx and into the body in a strong stream, the animal having sufficient intelligence to know and to reject what may be unpleasant or non-beneficial. With indigo it refuses to have anything to do; and a particle of any kind that may be too large, or otherwise unacceptable, scarcely passes the oral aperture before the current is reversed and the disagreeable substance dashed out.

Reproduction with the form referred to as *Tillina inflata*, n. sp. is accomplished, so far as I have observed, by encystment and subdivision of the body into four zoöids, which differ from the adult in no particular, except in their smaller size.

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COLONIAL ORGANISMS.

BY CHARLES MORRIS.

THE remarkable resemblance which appears between the separate segments of an Annelid, the distinct units of a Hydrozoan, or in the sectional parts of other forms of the animal and vegetable kingdoms, is one that admits of two interpretations and has in consequence given rise to two opposed theories. In the first, supported by several eminent scientists, it is assumed that each unit or segment represents an original individual, and that the existing individual arose through the subordination of the members of an original colony. In the second, supported by equally eminent authorities, it is assumed that the organs of an original individual gradually took on the form and functions of the parent body, and thus, though originally diverse in function grew to closely resemble each other.

This latter theory, which is based on the assumed tendency of each cell or other portion of an organic form to develop into an exact reproduction of that form, is supported by Huxley, Van Beneden and other biologists. The opposite theory, which is based on the apparently direct indication of the facts, is sustained by Allman, Gegenbaur, Claus, Lankester, the Hertwigs, &c. Late discoveries seem to sustain the colonial rather than the individual theory. The probable fact is, however, that they are both, to a certain extent, true, and that both the colonizing habit and the reproductive power of single cells have had their share in the formation of the closely similar sections of Hydrozoan and Annelidan individuals.

It is proposed here to offer a general consideration of the subject in its application to both the vegetable and animal kingdoms, and mainly from the colonial point of view, though with full acknowledgment of the tendency of the generalized parts of an organic body to assume the form of the whole, and the power of each unspecialized cell to act as a reproductive germ. It is quite possible that some new arguments may be advanced, and the whole subject be placed in a clearer light, since, so far as the writer is aware, no complete treatment of it has been yet attempted.

Organic forms are reproduced in two methods: by asexual and by sexual generation. The first, the development of unfertilized germinal cells, is the most common in the lowest forms of life. The second, the development of fertilized germs, or of germinal cells into whose composition enters material from two separate individuals, gradually replaces the first as life attains a higher grade, and completely replaces it in the highest forms. In connection with this is another fact of importance here. The products of asexual reproduction very commonly remain attached to the mother form, and compose colonies. The products of sexual reproduction never remain attached, but always enjoy a free existence. This distinction is markedly displayed in vegetable life, in which the product of the leaf bud continues, with few exceptions, attached to the parent form, while the product of the flower bud is always set free, to give rise to a new parent stock.

There is reason to believe that generalized cells, capable of reproductive development under proper conditions, exist abundantly in every part of every organism. In all the higher animals, if the views advanced by the writer in a preceding paper[1] be correct, these mainly exist in the blood current, as the amœboid white corpuscles. In many of the lower animals, in which specialization has made no progress, most or all of the cells of the body possess this power, and reproductive budding may take place at any part of the organism, or if it be cut into minute portions, each of these may develop into a new individual. In vegetable forms the latter condition seems to prevail. In the lower plants every cell may be capable of asexual development. In the higher plants the process of specialization has taken this power from the great mass of cells, yet vast numbers of cells exist capable of germinal

[1] Organic Physics, AMER. NAT., July, 1882.

reproduction. We venture to offer the hypothesis that the meristem, or generalized active tissue, is made up of such reproductive cells, each capable of asexual development, or of being converted, through the medium of the flower organs, into sexual germs. If this be correct, the meristem cells of plants represent in their germinal powers the generalized tissue cells of the lower animals, and the wandering white corpuscles of the higher animals.

Abundant, however, as germinal cells may be in every part of every organism, yet only a limited number of them can develop since their growth acts to exhaust the strength and substance of the parent form. Only in the lower single-celled organisms do we find instances in which the whole body is converted into active germs, and the parent disappears in its offspring. In all the higher animals and plants this only partially takes place, and the less so the higher the organism.

The development of the germ cells usually occurs only at those points where favoring conditions most fully exist. In sexual reproduction these points are particularly limited in number, since the requisite meeting of germs from two organisms can only take place through the aid of a special mechanism. Asexual reproduction needs no such special mechanism, and may occur in most regions of the body. Yet, as life advances in grade, the favoring conditions of asexual development will be apt to exist more abundantly in some regions of the body than in others, and tend to become confined to these regions by hereditary transmission. In the higher plants these regions are usually the leaf axils, in which a degree of protection is afforded the bud, or partially developed germ. But if a tree be closely trimmed, and thus deprived of all its buds, new germs may develop at any point in the secondary meristem of the trunk or branches, and new shoots appear, the product of germinal cells which otherwise would have lacked the opportunity to develop.

In the development of the germs of the root fibers or shoots no such protection is requisite, and they may start from any point in the cambium layer. They are evidently the product of those meristem cells, which have been most successful in the general effort to develop.

The reason that certain cells alone succeed in developing, out of the great mass of cells that possess equal germinal powers, is

an interesting subject to which some further attention is desirable. As already said, each developing cell to a certain extent exhausts the organism and checks the reproductive activity of other cells. What is the principle of selection of these fortunate cells? It would seem as if they must possess superiority in nutrition, or be most favorably situated for assimilating nutriment from the vascular juices of the organism. Thus growing rich in protoplasm, their effort to develop must be not too greatly hampered by the crowding of surrounding cells. They must have some freedom of field in which to expand. The cell most favored in these particulars will be the most likely to develop. As for the germ cell of sexual reproduction, it possesses these requisites in a high degree. It develops in a region which is richly supplied with nutriment, and where there is no hindrance to its expansion. Of the many cells delivered into this region it would seem that those richest in protoplasm should, all things considered, have the best chance to develop and become the germs of new organisms. In sexual development, however, there must enter a certain element of chance, since the meeting of ova and spermatozoa is, to some extent, a matter of chance, and the earliest fertilized ova probably have a degree of advantage over their rivals.

With these preliminary remarks we may proceed to the consideration of the colonizing habit as usually displayed by the products of asexual generation. Colonial organisms occur abundantly in the single-celled field of life, as in the Diatomaceæ, the Volvocineæ, the Foraminifera, the Radiolaria, the Flagellata, &c. In the multicelled field it is indicated throughout the vegetable kingdom, and in the Spongida, the Hydrozoa, the Actinozoa, the Polyzoa, the Ascidia, the Annelida and the Arthropoda of the animal kingdom. But these indications of colonial origin are by no means all equally distinct, and in some of the sub-kingdoms mentioned they are but vaguely discernible. Yet there is a gradual movement from the less to the more questionable colonies which is significant of a common origin.

In the colonies of Rhizopod and Flagellate Protozoa no traces of differentiation appear. Each individual is like all the others, and each is capable of separate existence. We cannot, in any proper sense, consider these colonies as compound individuals, though in the Foraminifera there is a slight tendency in that direction. This tendency is more markedly displayed in the

Volvocineæ, as we shall show farther on. It will suffice to say here that these colonies are the product of continued asexual reproduction, and of the coherence of individuals thus produced.

Of colonies of Metazoa those of the sponges are similarly the result of asexual reproduction, are unattended by specialization of any members of the colony, and their members may be separated and pursue individual lives, and produce new colonies. The sexually generated sponge, on the contrary, begins life as a free individual.

But the subject of the sponge leads us deeper into the question of reproduction. As is well known there are two hypotheses extant in regard to the classification of the individual sponge. In the one it is viewed as a colony of Flagellate Protozoa. In the other it is viewed as a single Metazoan. The former hypothesis is based on the cellular organization of the sponge, since most of the cells of its epidermal layer are essentially Flagellate Infusoria. The latter is based on the character of its reproduction, since the germ develops in Metazoan fashion and not by a process of colonization.

It has been assumed that these hypotheses are mutually exclusive, and that only one of them can be true. Yet this does not necessarily follow. They may both be true. The strong argument which each advances may perhaps be reconciled by a third hypothesis, or by a fuller consideration of the essential character of reproduction.

The assumption that a compound organism which is born as a single cell, and grows by asexual budding, is a Protozoan colony, and that one which is born as a definite compound of cells is a Metazoan individual, has its uses for purposes of classification, but it declares a distinction that has no real existence. If we consider birth in its true relations, all organisms are born as single cells, and their complete development takes place after birth. For birth really occurs at the moment in which the germinal cell ceases to be a part of the parent organism, and begins its individual life. Whether it is delivered directly into the surrounding elements, or into an ovary within the maternal body, the essential fact remains the same. It has ceased to be a constituent part of the maternal body. It occupies an external locality, either in the exterior world or in a cavity communicating therewith, and

its nutrition and growth have become distinct from those of the mother. The only discoverable difference is that in the one case the nutriment is obtained independently of the mother, in the other case it is for a time provided by the mother.

The phenomena succeeding birth are the same in both cases. Continued division of the germ cell takes place and a mass of cohering cells is formed. It is true that in the cases where this takes place within the ovary or the egg a definite form is assumed. But the same is the fact with the Foraminifera, the Radiolaria, the Fungi, and the other colonial organizations which arise exteriorly through the continued subdivision of a germinal cell. There is no essential distinction between the two processes. The only visible distinction is that in the one case all this subdivision takes place exteriorly to the maternal body, in the other a greater or lesser portion of it takes place in a cavity of the maternal body which communicates with the external world, or within a capsular inclosure provided by the mother.

The distinction, therefore, between Protozoa and Metazoa is by no means absolute, and the highest Metazoan is essentially a colony of Protozoa, since it is born as a single cell, and gains its mature form by a long series of asexual cell productions. Its main distinction is that many of these new cells are greatly specialized, while in the simpler cell colonies they are to a great extent generalized.

The most primitive organic differentiation is into free cell and coherent cell individuals. Of the former there are numerous instances in the Protozoan world, yet at a very low level of life asexually-born cells begin to cohere into colonies. From these, at a higher level, arises the only distinctive feature of the primitive Metazoan life, that of the formation of organized cell colonies within the maternal ovary or the egg, precedent to birth into the exterior world. However different this process may appear from the formation of the simpler cell colony, the difference is only in seeming, and the enclosed embryo perhaps very gradually succeeded to the external colony.

The first significant step in this direction is taken at the low level of the Volvocineæ. The globular colony of Volvox in fact acts as a sort of womb, into which are born asexual germs. These develop into embryo colonies within the maternal body. We have here an instance closely analogous to that of Metazoan

birth, and a significant indication of the origin of the latter. The sexual offspring of Volvox, however, is born as a single germinal cell.

In the vegetable world the free cell colony assumes a size and complexity considerably in advance of any animal instances, for the Algæ and Fungi begin their external life as single cells. Thus, however large and complex they become, the process of growth is distinctly that of cell colonization.

There is one important fact observable in all cell colonies. They do not display varying and indefinite expansion, but tend to assume specific forms. These organisms are probably results of natural selection, and possess the forms best adapted to the life conditions of the colony, which forms are hereditarily transmitted. Now we may readily conceive, in the numberless fluctuations of nature, the appearance of circumstances to which the mature colony would be well adapted, but in which the germinal cell and the growing colony would be in danger of extirpation. Under such circumstances it would be a decided advantage if the germ could pass through its first stages of division within the maternal body, and a still more decided advantage if it could be retained under the maternal protection until sufficiently developed to be able to take care of itself in the battle of life. Such, possibly, was the method in which the Protozoan cell colony became the Metazoan organism, namely, by the retention of the germinal cell under the maternal protection until it had unfolded into a self-sustaining organism. The degree to which this embryonic growth proceeds differs greatly in different cases. In all cases the new creature is born as a single cell. In the Protozoan colony it is shed into the external world at this stage. In the Metazoan it is retained until it has passed through a portion or the whole of its development, or, more usually, is born as an egg, in which the germ rests in a store of nutriment provided by the mother, and enclosed within a protective covering. Only in the case of the Mammalia is the development completed before external birth.

Thus the division of the germinal cell, in the formation of the Morula, is in no fundamental sense different from the division of the amœboid cell, in the formation of a colony of Foraminifera. The Flagellate colony, from which there is reason to believe that the sponge originated, may, in the process of evolution, have

gained a somewhat complex organization, protected by fibrous and mineral secretions. Perhaps primitively yielding its germs as free cells, to develop into colonies externally, it may, in the exigencies of the struggle for existence, have come to retain them until they had developed into organized colonies, capable of self-support. Yet during the long period in which these gradual changes took place, the cells of the sponge colony continued to retain the characteristics of the Amœbæ and the Flagellata, so that to-day they display the double character of a colony of Protozoa and of a Metazoan individual.

We have dwelt at considerable length on this one case, as it involves the principle at the basis of all organic development. There is one other matter of interest connected with it to which we may here refer. The retention of the embryo within the maternal body, or within the egg, has an important bearing on the question of evolution. This latter retention is a true "acceleration of development."[1] The embryo, while thus retained, is specially favored in its growth. Provided with food without personal exertion, as in the case of free cell colonization, none of its energies are exhausted, and that organic development which is so greatly favored by complete rest proceeds rapidly. Its condition resembles that of the insect in the pupa stage, in which, supplied with abundant nutriment, and in a state of complete rest, organic development is rapidly attained. Such is the case with the embryo within the egg or the maternal womb. Its development is strongly accelerated, its larval stages passed through so rapidly that many of them are slurred over, and only the more marked stages are discoverable, and the new individual, when at length forced to depend on its own exertions, begins its free life at a much higher stage than in the case of the germ that is shed into the external world as a single cell, or a very immature colony.

If now we come to the consideration of Metazoan colonies, we find a gradual variation from simple to complex conditions closely analogous to the parallel case of cell colonies. Many of the colonies of the Metazoa are nearly as simple as those of the Protozoa. Such is the case with the Ascidia and the Polyzoa. These colonies are compounds of precisely similar, asexually-born individuals, each of which pursues life as an individual, though

[1] Cope. Origin of Genera. 1868.

they seem to possess some degree of vascular and sensory connection.

A somewhat more progressed case is presented by the Actinozoa, in which the colony is united by a common stem, which is fed by the united labors of the feeding individuals, and through which these individuals possess some degree of vascular, sensitive and motor connection. The separate members of the colony here take a first step towards reduction into the organs of a complex individual.

In the Hydrozoa this subordination is much more declared. Each member of the colony has lost a portion of its life powers, and is thus an incomplete individual. Some feed only, and have ceased to reproduce. Others reproduce only, and have ceased to feed. The colonial life is a necessity, since each individual has lost a portion of its life powers. From being individuals possessed of all the life functions, they have become organs of a composite individual, but organs which are as yet, in nearly a complete sense, individual animals. If now we consider the swimming Hydrozoan colonies, the Siphonophora, a remarkable development of this principle of subordination makes its appearance. These complex animals yield strong indications of an origin in colonies of individuals, which have become quite incapable of a separate life. Each has lost not one only but several of its organic powers, and is reduced to the performance of a single duty, while dependent on its differently-developed neighbors for aid in its other duties. The original individuals have become degraded into organs through this loss of ability and limitation of their field of labor. Thus, at the extremity of the general stem of the Siphonophora, there is usually an individual converted into a simple bladder, and useful only for purposes of flotation. Beneath it are a number of others which act only as swimming bells, their sole duty being to rythmically contract and expand. On the remaining portion of the stem are individuals, some of which act as food catchers, others as mouths and digestive organs, others are limited to reproductive activity, and others again are reduced to mere covering pieces, in which all the life organs have disappeared, and which seem intended merely to protect the more active individuals. The common connecting stem acts as a vascular system, and probably possesses some degree of sensory and motor activity.

In the Siphonophora, then, the reduction of a colony of budded individuals to the condition of a single composite individual has greatly progressed, so far as indications go. Their embryological development points to such an origin. In fact, the Hydrozoa generally are born from the egg as ciliated planulæ, which, after a period of free-swimming existence, become fixed and develop the mouth and tentacles of the Hydroid type. Only later the polyp buds sprout and the polypary is formed. Thus their embryological development indicates the character of their phylogenetic evolution.

(To be continued.)

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REVIEW OF THE PROGRESS OF NORTH AMERICAN BATRACHOLOGY IN THE YEARS 1880–1883.

BY W. N. LOCKINGTON.

IN this department little has been done in the direction of descriptive zoölogy—probably little remains to be done in the limits of the United States, while the researches of Sumichrast Bocourt, Cope and others, must have nearly exhausted the riches of Mexico and Central America in batrachian forms. Fortunately the batrachia are still, as they have been, favorite subjects with the anatomist and embryologist, and to this fact we owe much of the material presented in this article.

The most important addition to North American Batrachology within the two years to which we are confined is certainly that of M. Brocchi, forming one of the quarto numbers of the magnificent work which for several years has been published under the direction of M. H. Milne Edwards, by order of the Minister of Public Instruction, and entitled "Mission Scientifique au Mexique et dans l'Amerique Centrale." The part already published, though containing only the Raniformia and a portion of the Hylæformia, comprises descriptions of seventy species, eleven of which are new. The classification adopted is unfortunately that of Dumeril and Bibron. The primary division of the Anura is into Phaneroglossa and Aglossa. The former group is divided into Hylæformia, Raniformia, Hemiphractiformia (having teeth in both jaws), Bufoniformia and Hylapesiformia, the last section containing forms which are toothless like the toads, but are without the dilated sacral vertebræ of the latter. The Aglossa are

divided into Dactylethriformia and Pipæformia, the latter without teeth in the upper jaw.

The classifications of Günther, Mivart and Cope are reviewed, the character separating the Bufoniformia from the Hylapesiformia, and that dividing the Aglossa, are taken from Mivart, while the reasons given for the rejection of Cope's views are: 1st, the difficulty that arises, in practice, when a valuable specimen can only be correctly placed by its destruction in the search for characters drawn from its osteology; 2d, the length of time necessary for the complete ossification of the batrachian skeleton, so that, unless the specimen is adult, it cannot always be determined to which section it rightly belongs.

The first of these objections is well answered by Mr. G. A. Boulenger, in the introduction to the catalogue of Batrachia Salientia in the British Museum, already noticed by us in Vol. XVII, p. 181. In adopting Professor Cope's system, Mr. Boulenger says, "Very little skill is required to obtain the necessary information without serious injury to the specimen. Herpetologists have long been in the habit of making an incision in the skin of the pelvic region for the purpose of ascertaining whether the diapophyses of the sacral vertebræ are dilated or not; a slit made in the same manner along the thorax will show the sternal characters, and another (which can be sewn up again) along the side of the body, will suffice for the examination of the structure of the vertebral column."

M. Brocchi's volume is illustrated by ten well executed colored plates, in which the external and craniological characters of the newly described species are shown.

Among the new forms are *Rana vaillantii*, *Rana macroglossa*, *R. maculata*, *Leptodactylus fragilis*, *Hyla plicata*, *H. pœnulata*, *H. crassa* and *H. guatemalensis*. For the latter the new name, Camphias is proposed, but this is a synonym of the Hypsiboas of Wagler, as defined by Cope. There are some other synonyms among the Bufones and Hylæ.

Among the species described from Mexico the following occur also in the United States, according to Brocclin, *Rana halecina* L., *Scaphiopus solitarius* Holbrook, *Hyla regilla* Baird and Girard (Oregon, California), *Hyla versicolor* Harlan, *Hyla verrucosa* (Florida) and *Hyla cadaverina* Cope (Pacific Region).

Miss M. H. Hinckley (Proc. Bost. Soc. Nat. Hist., 1880) details

her observations upon the metamorphoses of *Hyla versicolor*. Eggs laid May 10th become frogs on July 4th. In two days after deposition all the ova were hatched, in four days the external gills were developed, in eight days the external gills were completely resorbed on both sides; and in seventeen days after deposition the hind legs commenced to bud, but the fore-legs did not both become free until about July 3d, by which time the edges of the tail were undergoing resorption. The tail in some cases disappeared in thirty-six hours.

Miss Hinckley also describes and figures (Proc. Bost. Soc. Nat. Hist., 1882, pp. 307–315) some differences in the mouth structure of the anurous batrachia of Massachusetts. These fall into three groups, which characterize the frogs, tree-frogs and toads. In the first the upper lip is shorter and narrower than in the others, and a papillose border, bending inwards at the angles of the mouth extends around the lower lip and overlaps the upper slightly on both sides.

In the tree-frog tadpoles observed (*Hyla versicolor* and *Hyla pickeringii*) the upper lip is broad and falls into two deep curves, along the lateral portions of which extend papillæ like those of the lower lip. The papillæ are small, and the papillose border does not bend inwards at the mouth angles. In the toads, *Bufo americanus* and *B. fowleri*, the upper lip is broad and nearly straight, and the lower lip is fringed and without papillæ in the the center.

The upper lips in all the species, the under lips when not edged with papillæ, and several fleshy folds which extend across both lips, especially the lower, are fringed with what appear in the microscope to be closely set teeth of uneven length. These fringes serve to collect and hold the food, both upper and under lips being used for this purpose; and Miss Hinckley observes that animal food appears to be preferred to vegetable by young tadpoles. *Rana sylvatica* has four fringed folds on the lower lip, while the other Ranidæ observed have three. *Hyla versicolor* has three fringed folds on the lower lip, while *Hyla pickeringii* has but two, and a short space of fringe on the margin of the lip. The same observer has also some notes on the development of *Rana sylvatica* which in many respects appears to be very distinct from other New England Ranidæ. It congregates earliest in spring for the business of oviposition, but cannot move in water below 45°F.

As many as 1380 eggs are contained in a single mass. The time in which the eggs develop varies greatly according to temperature. The metamorphosis of the tadpoles observed occupied from April 12 to June 9th, when the tail had wholly disappeared, and tadpoles which on May 31st measured 58^{mm} in length were reduced to young frogs 18^{mm} long. The external gills became fully developed two days after hatching, and in four days more were entirely resorbed, leaving an opening through which the action of the internal gills could be seen. The legs budded on May 6th, and by May 20 the feet and toes were well defined.

In the *Canadian Naturalist* (Vol. 9, p. 160), Mr. H. Montgomery observes that examples of Menobranchus kept in an aquarium plentifully stocked with mollusks fed entirely upon fishes.

Mr. W. Frear, in a note to the AMERICAN NATURALIST, gives a curious instance of the vitality of this batrachian. An individual that had lain exposed to the summer sun for forty-eight hours, and had been completely covered with alcohol for twenty hours gave undoubted signs of vitality, by opening its mouth and swaying its tail, when placed on the dissecting table.

Mr. J. S. Kingsley (Proc. Bost. Soc., 1881) notices a case of polymely, or the development of an additional limb, in an example of *Rana halecina*. The supernumary limb, is in origin and structure a limb of the left side, but occupies nearly the position of a tail. The myology of the proximal part of this extra leg is far less perfect than that of the distal, but the most singular abnormality is the formation of an acetabulum for the odd limb at the symphyis of the pubes.

Wm. E. Carlin (Proc. U. S. Nat. Mus. 1881) states that large numbers of the *Siredon lichenoides* of Como Lake change every season to the Amblystoma state, but that the change takes place much more slowly in the alkaline waters of the lake than in fresh water.

S. F. Clarke (Johns Hopkins University, Studies from the Biological Laboratory) gives the result of observations upon the development of *Amblystoma punctatum*. The eggs are deposited in masses of from two to three hundred, each covered with a tenacious gelatinous coating, at first thin, but rapidly becoming thick by absorption of water. Thus each egg consists of two membranous shells, separated by a space filled with clear fluid, and is well protected from voracious fishes. In the act of depositing

the ova, the female lies with her anterior limbs extended laterally, and her hind limbs curved round the opening of the cloaca, apparently to assist in holding the eggs together. If disturbed she leaves the spot, and commences the operation elsewhere. The male deposits the spermatic liquid upon the eggs. The spermatozoa are very large, .75 millimetre in length, while those of Menopoma are only .25^{mm} and those of *Rana temporaria* .008$^{mm.}$ They are long slender filaments, pointed at both ends. The ova, as usual in Batrachia, have a light and dark-colored pole, but the dark portion, instead of being much smaller than the light one, as is frequent, is equal to it in size, so that the third segmentation furrow is equatorial. After this furrow is formed segmentation proceeds most rapidly at the light colored pole, which is always the lowest, and the dark area increases until the only light part left is a small area around the lower pole, and extending upward from on one side. This white area then becomes surrounded by a furrow, and forms a prominence, the "vitelline plug" of Ecker. Gradually the vitelline plug sinks into the mass of the egg, except a very small round spot, from which extend outwardly the rudimentary walls of the medullary folds. By the end of the fourth day these folds have spread anteriorly to the cephalic end, and the egg has now become elongated in the direction of the medullary folds and their central groove. In about nine hours more the neural tube is enclosed, by this time the embryo has much increased in size and weight, and the entire surface is covered with cilia. A constriction next defines the head, and the optic lobes appear as oval prominences. The throat is next marked off, the proto-vertebræ appear, branchial lobes are developed, and the anterior limbs indicated. The tail lengthens, and the balancers, so-called from their resemblance to the balancers of dipterous insects, appear between the eyes and branchial lobes. Active muscular movements next occur, the gills are defined, the pulsations of the heart are visible, and pigment cells are produced. Most of the energy is now devoted to the growth of the gills and balancers, and at the next stage the caudal and dorsal fins grow actively. The balancers, held out so that they point outwards and downwards, aid in keeping the head and branchiæ free from the dirt at the bottom; they decrease as the anterior limbs increase, and finally break off, about twenty-eight days after the vitelline plug was formed. With the appearance of the third digit of the anterior limbs the lobes that will form the hind-

limbs commence to bud. At the age of sixty days all the external parts are formed, and it undergoes no external change except growth until the branchiæ are resorbed, a process which occupies from three to five days. The entire series of changes, in vigorous examples, occupies about a hundred days.

The same writer gives an account of the development of the Wolffian body in this salamander. It arises from the outer layer of the mesoderm as a solid rod of cells, and is at first largest anteriorly, a dorsal and ventral duct are then formed by the splitting of the cells, and an opening into the body cavity is made from the dorsal duct. The method of development of this organ differs from that observed in allied forms that have been worked out, and is most like that of the Elasmobranchiates.

The same laboratory furnishes some interesting notes upon the secretion of the pepsin-forming glands of the frog, by H. F. Sewall. The œsophageal glands, which, when the intestinal canal is empty, are full of fine granules, undergo marked changes in digestion, losing the greater part of these granules during the process. These changes are started by the mere absorption of matter from the alimentary canal, but the regeneration of the glands depends upon the presence of new matter in the blood itself.

The fifth Bulletin of the Illinois State Laboratory of Natural History is a list of the Batrachia and Reptilia found east of the Mississippi, by N. S. Davis and F. L. Rice. *Siren lacertina* is credited to Northeastern Illinois. The Bulletin No. of the U. S. National Museum consists of a check-list of the Reptilia and Batrachia of North America. The classification is based on that of Professor Cope, as set forth in Bulletin No. 1, of the same series.

The work of Dr. J. J. Mason, upon the minute structure of the central nervous system of certain reptiles and batrachians is a valuable addition to our knowledge of brain-structure in the latter, illustrated as it is by artotype plates taken from negatives made by the author. Numerous sections of the spinal cord and brain of Rana, Menopoma, Diemyctylus and Siren are given. The transversely-developed spinal cord of Menopoma, deeply fissured posteriorly, contrasts greatly with the oval and slightly fissured form of that of Rana. The writer does not claim to distinguish between motor and sensory cells, and considers that the theory which makes the nuclei the true function centres of the nerve-cells, is an unproved one.

WOOD NOTES AND NEST HUNTING.

BY HORACE LUNT.

PASSING along an old dam, now unappropriated and neglected, where, on either side of it, trees have since its building grown to maturity, now watching for awhile the adventurous bream which approaches the shallow water for Gerris and water-beetles, and whose motions appear to be dull and heavy by the surfeit of this continual feast, my eye is arrested by another insect-catcher of the air, the wood pewee. With what unerring precision it darts upon some aspiring beetle, and returns to its observatory on the opposite shore!

This bird is not shy when engaged in its legitimate pursuits, and will allow a very near approach. His head is continually moving from side to side; he occasionally stops, however, to preen his breast feathers; which seem to be always ruffled, or with uplifted claw to give his crown a series of quick, spiteful digs, and with droll performance peer under his outstretched wings for a troublesome parasite. Now he darts off, flying fifty yards away in a straight line, to gobble an insect which he sees at that distance, not returning to his post, but to a sycamore growing on the dam. This is the season of incubation, and I suspect, considering the good provider and kind husband that he is, that this tid-bit just captured is for his consort.

No one, without the aid of the bird, could expect to find such a nest. How nicely it is saddled on the end of a horizontal bough, thirty feet from the ground, so shallow that one can see, even at this angle of vision, the head and back of the female as she sits upon it. The couple did not wander far for their building material, for the nest is chiefly composed of mosses and thin plates of old bark that cleave from the young growing liber, so characteristic of the buttonwood, glued together with saliva, which nature has so bountifully supplied to many of the birds. There she sits, evidently not caring whether her nest or her presence has been discovered. Her head moves about freely, and once she cannot resist the temptation of flying off to seize a passing insect, but returns immediately to her task. Here comes the male once more, and standing close beside her, gives a kiss and a beetle in the bargain. How gallantly he breaks it to her, while she, as is her prerogative, receives it with cool indifference,

and bids him go for more. As he stands on the branch an instant, his back toward me, and the broad leaves uplifted by the wind let in a sunbeam upon him, I note a shade of dark green and the long pointed wings, reaching down half way on his tail, which is not so deeply forked as is that of the olive-sided fly-catcher, a first cousin, whom he otherwise much resembles. When he rises I see in this individual an exception to the general dress of the under parts of this species. The pale yellowish tint of the breast is replaced by whitish ash. The song is not often heard, as if he was aware of the melancholy strain, and had the good sense to consider the feelings of his mate during the distressed period, and worked for her crop's sake instead. Resting on this slope in the shade of the beech trees, watching the gambols of a pair of large purple-black butterflies (*Vanessa antiopa*) flying high up among the trunks, attracted there, no doubt, by the nectar that exudes from the bark, I hear the energetic notes of the oven-bird or golden-crowned thrush (*Siurus aurocapillus*). Immediately after a little bunch of feathers drops down from a low branch, and goes pecking here and there on the ground, not a rod from where I am sitting. He takes long, quick strides, as he turns his head to look at me, now half tumbling over dead sticks that lay in his path, or getting his long hind claw tangled in the blackberry vines, and making little exertions to clear himself. Now he runs swiftly ahead to capture a beetle or turns back quickly sideways for some crawling dainty which nearly escaped his notice. How much the color is like that of the leaves and grasses and vines through which he forages. The upper parts are of dark olive-green, with two dark streaks on the crown, and a broader brownish-yellow one between them, with the breast and sides of dirty white, streaked with black.

I believe not many of the birds sing while upon the ground. They love to mount some kind of stage, on which to pour out their melodies. But the golden-crowned hardly thinks it worth his time to take the pains to fly to a music stand whenever the inspiration siezes him, but stops his feeding for a brief interval, lifts up his head an instant before commencing, as is the habit of some of our best singers, and utters in a loud clear tone the syllables *cheat-er cheat-er cheat-er*. The song is not like any other in the woods. Listening to his lay at noon-time, when the sun's rays are pouring down on the mosses, one imagines it is not so

sprightly as in the morning. There appears to be a dragging of the notes, as though the little songster was worn out with the heat, and although he may be very near you in shade, the first syllables seem to come from a distance, showing his great powers of ventriloquism, gradually sounding nearer and louder, until he reaches the climax. This is his commonplace humming after all, for Mr. Boardman, a close observer of the birds, says he has another song at times, so rare and beautiful that but few know it as from that bird.

His nest is not far from here, for when I happen in this vicinity his song is sure to be heard. He likes just such a place as this, shaded slopes near a stream. As you walk along you see hundreds of depressions, little hollows under the roots, crevices in the ledges, and hide-away places generally in which you would choose to locate a nest, but thus far it has escaped my search. How shrewd these birds are in concealing their homes, not only from the sight of man, but often, as they must, from the sharper cow bunting, whose special instinct it is to intrude upon them, and from the numerous greedy prowlers that go nosing round, both night and day, for just such morsels as the nests of these ground builders offer.

The general intelligence of birds, considering their comparatively low position in the scale of creation, seems to me remarkable. How alert they have learned to be on account of these surrounding dangers. How many little schemes they invent to deceive you. This same golden-crowned is a curious bird. He likes to be near you, though he does not want you to be aware of it; so he flies swiftly past, far enough, he probably thinks, for you to lose sight of him, when he makes a detour, and finally comes back again along another air line, and flits behind a rock a few yards away, with the probable satisfaction that he has completely outwitted his vexatious follower, and can watch you at his leisure without being observed himself.

It is amusing also to observe the cuteness of these crows, whose young are nested in a tall pine near by. Only a stifled suppressed scolding croak escapes them now, as though it was hard for them to keep in so long. If they could give a few loud disagreeable caws it would be such a relief; but it behooves them to be silent, that their enemies' attention may not be directed to this one place on earth, wherein is centered all of their affection.

Two small birds, with ashen heads and olivaceous backs, and breasts of reddish-yellow, flutter down as noiselessly as butterflies, close to my rather uncomfortable position, in a patch of green-briers and blackberry vines. They have taken me by surprise, and almost before that feeling has been replaced by inquiry they have moved off again in their nervous way, flying in all kinds of places, now down to the ground, or zigzagging among the shrubs or smacking with their bills among the leaves, as they glean in the highest branches of the elms and willows. At length one, with undulating flight, wings its way to a small cedar, and hides in the thick foliage. The movement is so different from the usual manner of proceeding from bush to tree, that one suspects a subject of great importance possesses the bird, and watches sharply for developments. Sure enough, there in the horizontal fork of a limb, not fifteen feet high, the American redstart (*Setophaga ruticilla*), the red-tailed insect eater, has laid the foundation for a nest. From a human standpoint, the locality is not well chosen; situated as it is, quite near a wood-path, and in full view of every young rambler who may feel disposed to rob. Though placed in this opening, how nicely the general colors of the material of which it is composed harmonize with that of the bark of the limb. No one without the aid of the bird would discover it, it is such a wee bit of a construction, and so accurately fitted among the smaller twigs. How busy the little worker is. Though taking observations quite near, she does not appear in any way disconcerted, but works on as if her very existence depended upon completion of the nest in a given period of time. Here she tugs for a bit of lichen, which will match well with her home surroundings. There she flies down in the swamp for a particular bit of sodden last year's plant-stem, to suit a certain defective place in the side; she knows where it belongs. The dead branch of a willow, almost denuded of bark, which the rain and sun, year after year, whips into fine cottony nesting stuff, offers material, and to this she often goes for rifting pieces. Half flying and hopping along its length, she searches for a loose end, and when it is found, stops, and having secured a fast hold with her beak, gives a sturdy upward pull, which evidently requires all her strength to remove the bleached strip, and flies with it to her home.

She always builds from the inside, never placing material on the nest while standing outside of it. The cavity must be looked

after and nicely turned and pressed to fit her precious little body, so she gets in and squats and turns round and round with outspread tail and wings, tucking in here and there, and fastening with saliva the stray ends, and hugging with her chin and bill the outside edges against her breast. The delicate structure is progressing rapidly, and the female appears to be the chief architect and worker. If the male comes it is only to flaunt himself before her and disappear. These are evidently young birds, for on the occasional visits of the male I notice the color is similar to his wife. His tail coverts and tail, however, are darker with perhaps a deeper orange-red on the sides of the breast. He will have to wait a year or two before he puts on the uniform of black and red that older male birds wear.

In a week the nest is finished; the upper parts are slightly drawn in and compactly thatched. Now that the task is off her mind, she appears more cautious, and uses many little devices; fluttering among the lower branches or flying into the farthest side of the tree and skulking up to the nest, with the hope that her skillful manœuvering has been successful in eluding my vigils. As I approach the nest she utters a sharp *chip*, *chip*, precisely like the note of the hair bird, but does not manifest any extraordinary signs of distress. She remains at her post of trust till the last second, and then eyes me keenly from one of the branches above, as if she had the conscious power to prevent me from stealing away her home. It is a deep cavity, upholstered with fine grasses and a few horse-hairs, on which rest already two tiny eggs, the ends of which are very unequal, tapering quite acutely from the larger part. The ground color is white, blotched with reddish-brown, as if the bird had rubbed on them some of the coloring of her breast. I dare not breathe on the sacred things lest the parent consider them polluted, and forsake the dearest spot to her on earth. No fear of her! Sensible to the last, she seems to have comprehended the object of my visit, for hardly have I withdrawn a reasonable distance when she again flies to her nest, and with a cant of her head, as she stands on the edge, says: "There, you big fellow; I trust you are satisfied with your investigations. Now leave me to finish my work in peace."

In this thick clump of high blueberry bushes, interlaced and overgrown with greenbriers, madam catbird has improvidently

made her home. While looking through the interstices of leaves and sprays from the other side, to observe the devoted actions of the pair, I discover another oölogist, but with more hostile intentions than the writer. A small striped coachwhip snake has laid the several portions of its lithe body conveniently along the twigs and there remains as motionless as any part of the bush. After watching it for a time, I make various noises to ascertain to what extent it can be affected by sound, and seeing that it does not stir from its resting place, I slightly shake the bush, when it lowers its head, darts out its forked tongue, but seems unwilling to move. Nature has given to its skin the general hue of the bark, and probably it instinctively remains in this position, relying more for protection on the harmony of color and being at rest than upon escape by any other means. Just as I am about to take more vigorous measures for its removal, the bush is struck by a sudden breeze, which appears like a palpable intervention; while the serpent takes advantage of it, and glides through the tangled mass out of reach.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The Society of Naturalists of the Eastern United States held its first full meeting in Columbia College, New York, during the Christmas holidays. The aims of this body, so far as they are developed, appear to be to sustain the business aspect of the pursuit of natural science in a material and practical way. The papers read related to the means rather than the ends of the scientific career, no discussion of subjects of pure science being in order. The questions discussed may be classified as follows: (1) The methods of original research. (2) The methods of teaching. (3) The constitution of societies and academies of science. (4) The employment of competent specialists by the educational institutions of the country. In each of these departments much is to be accomplished in this country, and none who attended the meeting failed to gain ideas on these topics. The society has chosen to restrict its geographical range in order to relieve its members of the necessity of traveling long distances, which considerations of time and money render impracticable. It is anticipated that other sections of the country will adopt similar organi-

zations, should they feel the need of them. A committee to define the terms of membership was appointed. The time of holding the annual meeting was fixed for the Christmas holidays as most convenient for teachers.

The goodly attendance and interest shown in the meeting, proved that the City of New York was the most convenient place, and that the holidays are the best time for such a meeting. Members from the leading colleges and museums of New England and the Middle Atlantic States were present, and the sentiment that such a society had an unworked field before it was generally entertained. The topics were in nearly every case of a practical nature, such as the methods of lecturing, of teaching, of laboratory work, of the arrangement of museums, both from a scientific and educational point of view. Biology is to be more and more dependent on exact and careful methods of preparing material for study, and hence a large amount of attention was devoted to histological methods and processes, such as the cutting and staining of microscopic sections, methods used in the microscopic study of rocks and to allied topics. The relations of the original investigator to the public, and the necessity of maintaining academies and institutions for original research was discussed. The society has begun well its work, and will doubtless, by the numbers of applicants for membership which were presented, become a live, zealous and wide-awake body of working men. Its membership should, however, be carefully selected, so that it may not be too unwieldy, and be burdened with too much dead wood.

—— It is to be earnestly hoped that the three great national scientific bureaus will obtain due recognition from Congress this winter. We refer of course to the National Museum, the Geological Survey and the Fish Commission. The results of these organizations are doing infinite good in aiding to counteract our utilitarian and non-intellectual tendencies, and the country cannot underestimate the value of the labors, especially of Professor Baird and afterwards of Hayden, Wheeler, King and Powell, in originating and conducting these admirable enterprises.

The disposition of the surplus which the Government is annually accumulating, has become an important question. Congress cannot do better than appropriate it for the advancement of science by fostering those great works which by their nature are too expensive to be undertaken by private persons. The money may be much worse spent.

RECENT LITERATURE.

MISSION SCIENTIFIQUE AU MEXIQUE; RECHERCHES ZOOLOGIQUES: TROIS. PARTIE, RECH. SUR LES REPTILES ET LES BATRACIENS, par MM. Duméril et Bocourt.—This part of this magnificent work advances well into the Ophidia, which is the only order remaining to be completed to bring the series to a close. Forty-eight species are described, of which thirty-six are figured as to the details of the scutellation of the head and adjacent parts of the body. These figures are nicely executed, and two of them, representing species of Ninia, are full length and colored. This work brings the subject of Mexican Ophiology nearer to date than any general work, and includes a number of species of North America and the West Indies. We have not been able in previous numbers to praise the systematic treatment of the subject, and the present number presents rather more numerous defects than any of its predecessors. Thus the species described purport to belong to the group Calamariinæ. Nevertheless it is quite certain the serpents like Ninia cannot belong to the same natural group as Catostoma and Carphophiops, the only character they possess in common being their *small size*. I have shown in fact[1] that Ninia must be arranged with Storeria and Tropidonotus on account of the presence of hypapophyses throughout the dorsal vertebral column. As to nomenclature, the failure to adopt the names of Baird and Girard, where they have priority of date of publication over those of Duméril and Bibron, is a serious error. Inconsistencies in nomenclature are observable. Thus Chersodromus is adopted, while Colorhogia, which rests on the same differential character, is not adopted. The genus Enulius is wrongly identified. We now give a corrected nomenclature of the species mentioned in this work:

Geophis hofmanni should be *Colobognathus hofmanni* Peters. Geophis semidoliatus, chalybæus, dubius and rostralis, should be *Catostoma* respectively; and Geophis rhodogaster Cope, should be *Colophrys rhodogaster* Cope; Carphophis amœna = *Carphophiops amœna* Say; Enulius murinus should be *Geagras longicaudatus* Cope; and E. sumichrasti, *Geagras sumichrasti* Boc. Conocephalus D. & B., is *Haldea* B. & G.; Streptophorus D. & B., is *Ninia* B. & G., and St. sebæ D. & B., 1854, is *N. atrata* Hallow., 1845. Lamprosoma Hallow., was long since changed to *Chionactis* Cope, because preoccupied; and L. episcopum is *Contia episcopa;* Cryptodacus redimitus is *Colorhogia redimita* Cope. Conopsis includes three genera, as I have pointed out. *C. nasus* and *C. maculatus* properly belong to it, while C. lineatus is *Toluca lineata* Kenn., on account of the presence of internasals. C varians belongs to the genus *Ogmius* Cope, on account of the presence of grooved teeth.[2] In the same way Ficimia ornata is distinct from Ficimia

[1] Proceedings Phila. Academy, 1864, p. 167.
[2] See Journal Academy Phila., 1875, p. 142.

in the presence of internasal scuta, and should be referred to the genus *Gyalopium* Cope, of which it is the second species. It was described some years ago[1] as *Ficimia publia* Cope. The Pseudoficimia pulchra is the *Geagras frontalis* Cope,[2] the difference from the other species of Geagras figured on the same plate, *i. e.*, the separation of the nasal from the preocular by an interspace not being of generic value. Scolecophis Fitz., should be *Scolecophis* Cope, who first described the genus. Homalocranium D. & B., is *Tantilla* B. & G., of prior date. Here should come the genus Enulius Cope, which is truly glyphodont, though the authors of this work assert the contrary. Ogmius should also be placed near to Stenorhina in the glyphodont series.—*E. D. C.*

CHAMBERLAIN'S GEOLOGY OF WISCONSIN[3].—This is not only one of our best State reports, but one of the most valuable and interesting. Beginning to look casually over the first part of Vol. I, entitled General Geology, by the chief geologist, we expected to find the usual résumé for popular use, but while it is entertaining, for it held our attention from its able summary of the whole story, it will continue to have permanent value from its discussion of the Archæan age as well as the Glacial epoch. We should unhesitatingly recommend any beginner or advanced student in geology to read this part of Vol. I in connection with his geological manuals.

The candid, well-balanced mind of the chief geologist is seen throughout the entire narrative as well as in the discussions and references to the opinions and works of others. It is evident that the survey has been in good directive hands, while the reports of the assistants prove that the details have been carefully and skillfully elaborated. The people of Wisconsin are to be congratulated on the results of such excellent work, and on having them presented in a simple, intelligible form.

Beginning with the hypothetical and pre-Laurentian history of Wisconsin and of North America in general, which is discussed in a fresh and comprehensive way, we find a good sketch of the Archæan age, which seems to us, in some points, more satisfactory than that given in the text-books. To be sure nearly every point of interest connected with this age is under debate. Professor Chamberlain, however, adopts Selwyn's view that the upper portion of the Laurentian, *i. e.*, those strata bearing the great beds of limestone and iron, as well as graphite, belong in reality to a later or Huronian age. "All the facts thus far disclosed in Wisconsin support this view, which, pending the results of investigations which must yet occupy some years, we shall assume to be

[1] Proceeds. Phila. Acad., 1866, p. 126.

[2] Loc. cit., p. 142; *Toluca frontalis*, Proceeds. Phila. Acad., 1864, p. 167.

[3] *Geology of Wisconsin. Survey of 1873–79.* Vols. I–IV. Atlas of maps. Vols. I, IV, 1882 '3. 8vo.

the correct one. The Archæan limestone and iron-ore beds of New York are likewise considered to be Huronian."

Succeeding the Huronian, a great formation, 40,000 or 45,000 feet in thickness, of which probably three-fourths is igneous material, and known locally as the Keewenawan period, is described. This is supposed to represent the Acadian rocks of the Atlantic border of New England and the provinces, and probably the Lower Cambrian formations of Great Britain and Bohemia.

The author discards the term period, and we think more logically regards the Laurentian and Huronian as ages, remarking: "In standard works on geology it is customary to dismiss all that precedes this era with a few pages devoted to the Laurentian and Huronian *periods*. In some, indeed, the latter age is not even separately recognized. When best considered these divisions are ranked as periods, and thus placed in the category of formations that often measure fewer hundreds of feet than these do thousands. Even in the more extended views presented in this sketch, relative injustice is done the earlier eras. In discussing the Laurentian, measuring as it does accumulations many thousands of feet in thickness, we only consider it as a whole, making no attempt at even an enumeration of the subordinate periods of deposition that marks its history. Even in describing the Huronian system we barely enumerate the successive thick deposits, though they embrace rich and varied accumulations of ore, carbon and lime, besides common detritus. Were these unmodified members of the later systems, they would doubtless be ranked as important periods, and the whole Huronian system would be graded as the equivalent of the Devonian age, or perhaps of the Mesozoic era."

For these and other reasons we like, on the whole, the author's tabular view of the geological eras, ages, periods and epochs.

The portion relating to the Quaternary age, particularly, gives a most useful and clear summary of glacial geology, especially in the Wisconsin and adjoining areas. Two glacial epochs are described, their existence clearly proven, and the colored restorations or theoretical maps of the two periods will be found to be most useful and timely. We have nowhere met with a clearer and more comprehensive exposition of the subject, and the proof that the great lakes were mainly excavated by ice seems, contrary to our own impression, quite reasonable. Space will not permit us to notice the work of the able collaborators of this survey, especially that of Mr. R. D. Irving, the late Moses Strong, Mr. R. P. Whitfield, Professors L. C. Wooster and F. H. King, and others. As they stand, the four volumes of this survey are a notable addition to our geological literature.

U. S. Fish Commissioners' Report for 1880.[1]—The annual reports of the U. S. Fish Commission reach us each year, of just

[1] *U. S. Commission of Fish and Fisheries.* Part VIII. Report of the Commissioner [S. F. Baird] for 1880. Washington, 1883. 8vo, pp. 1060.

so many pages, seldom, if ever, under a thousand, replete with matter of interest to naturalists and to fishermen, as well as to the general public, together with some padding to fill out the portly tome. The most notable zoölogical contribution is Mr. Goode's "Material for a history of the sword fish," a comprehensive account including a notice of the fisheries. It comprises ninety-nine pages and twenty-four plates, and is published rather to stimulate inquiry than as a complete monographic account of these fishes, so difficult to carefully study in nature. A large proportion of the report is filled with translations of foreign papers on different piscicultural topics.

ADOLPH'S MORPHOLOGY OF THE WINGS OF HYMENOPTERA.—This important memoir was published during the past year in the *Nova Acta* of the Imperial Leopold-Carolinian German Academy of Naturalists, under the title: "On the morphology of the wings of Hymenoptera. Forming a contribution to the question of the origin of species and of atavism." It is illustrated by six plates, five of which are filled with photograms of portions of wings, illustrating the variations and abnormalities in the venation. It is in continuation of an earlier similar work, published in 1882, on insect wings.

It is impossible to make an abstract of these interesting researches on the variation of venation, as the author does not present us with one. He closes the work, however, as follows: "The number of drones of *Apis mellifica* here studied amounts to 1918; of these 889 specimens with 2107 anomalies of thirty-eight different types or formations (bildungen) were surveyed in the most exact manner in tables, the remaining ones only with reference to the rarest forms. Three hundred and twenty-six worker bees and 125 queens were brought together for comparison. Among isolated deviations have occurred only those figured on Taf. 5, fig 2; Taf. 4, fig 5, and these indeed have a noteworthy relation to the allied kinds of venation. All the other anomalies are united in a strong normal relation. * * * Until the present time the venation has been used only for systematic uses. But now they have an interest from other points of view, and especially valuable are these abnormal formations which are opposed to artificial specifications and break over the limits to species which our comprehension of Nature has raised. It would be difficult to find a species which affords so rich a mine as the drones of *Apis mellifica*. But much is accomplished if we no more hastily throw aside, but consider it worth while to give thoughtful consideration to and compare them with other—be they normal or deformed—venations. In the Hymenoptera especially is the use of the venation in the discrimination of species nearly exhausted. There is a possibility still open, through these researches, of opening a new line of inquiry, whose perspective reaches far beyond the consideration of purely entomological questions."

THE STANDARD NATURAL HISTORY.[1]—We have received six parts of what promises to be a most timely and excellent work. The publishers and editors have gone to work in the right way in securing the aid of specialists in writing upon special groups. In this respect the work will be an advance even upon Brehm's Ani-

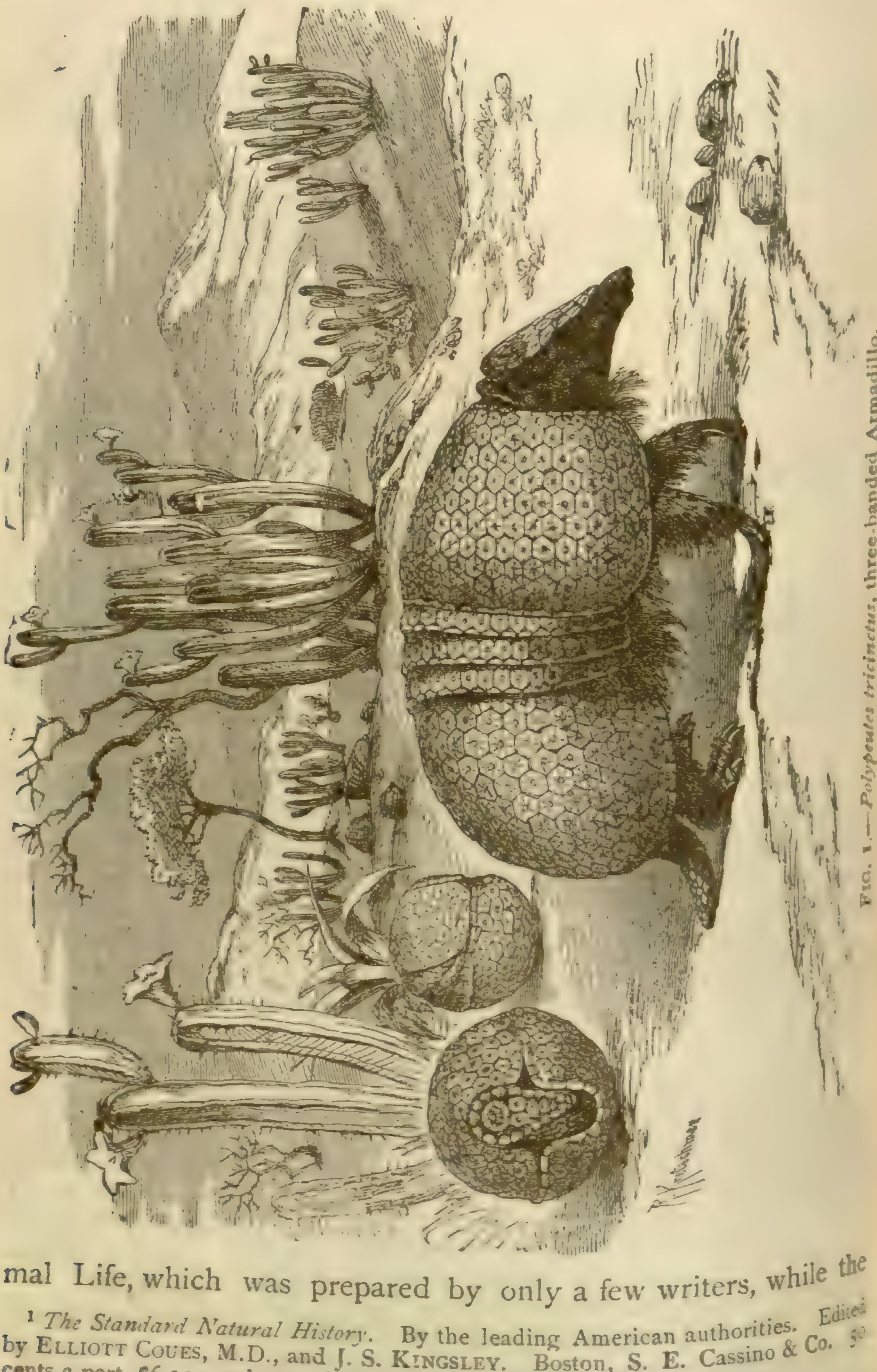

FIG. 1.—*Polypeutes tricinctus*, three-banded Armadillo.

mal Life, which was prepared by only a few writers, while the

[1] *The Standard Natural History*. By the leading American authorities. Edited by ELLIOTT COUES, M.D., and J. S. KINGSLEY. Boston, S. E. Cassino & Co. 50 cents a part, $6.00 a volume, cloth.

editors of the present work have engaged nearly forty collaborators. The difficulty will be to secure sufficient unity in the mode of treatment by so many authors; but we do not see any marked signs of this in the parts before us. This is a subscription work, and most publishers of such works for popular sale are timid and even silly about admitting anything that looks like evolution, but

FIG. 2.—*Dasyurus ursinus*, Tasmanian devil.

the present work is as it should be, in accord and in fact based on this principle. We notice in the parts before us that the Protozoa are treated by Mr. Romyn Hitchcock, the Infusoria by Dr. D. S. Kellicott, the Crustacea by Mr. J. S. Kingsley and Professor E. A. Birge, the mammals by Dr. Coues, Professor R. R. Wright and Professor T. Gill. The names of the other contribu-

tors are a guarantee of the permanent value of what will be a representative American work. It should be widely patronized. The illustrations are ample, many indeed from European sources, but with many original sketches. The paper and presswork are faultless. The work is to be issued in six imperial octavo volumes; Vol. I is to be devoted to the lower invertebrates; Vol. II to arthropods; III to the lower vertebrates; IV to birds; V to mammals, and VI to the races of man.

DAVIS AND RICE'S NORTH AMERICAN BATRACHIA AND REPTILIA FOUND EAST OF THE MISSISSIPPI RIVER.[1]—This little book presents us with the best synopsis of our cold-blooded land Vertebrata of our region which has yet appeared. The characters of the divisions are better drawn than in most American general works, though this is not very high praise. In fact there is room for much improvement in this respect, and it could hardly be otherwise, so long as no general work based on a general revision of the subject is yet published. The greatest defect is seen in the artificial keys, which are only evil, and that continually. It is well enough to have them, but they can be so constructed so as not to make specific and individual characters appear to be of generic or even of higher value. Similar objection may be made to the artificial keys in Jordan's Manual, and Coues' Key to North American Birds.

The authors extend our knowledge of the geographical distribution in a good many important points.

ON THE FORMATION OF THE EGG AND THE BLASTODERM IN THE VIVIPAROUS APHIS, by Ludwig Will.[2]—*I. The Formation of the Egg.*—Will studied by means of sections and fresh preparations the ovarian tubes of the viviparous form of Aphis. He found that the terminal chamber differed, in histological details, considerably from that hitherto described by authors. Huxley, Leuckart and Claus considered that the terminal chamber of the oviparous Aphis differed considerably from the viviparous form, not only in the whole arrangement and signification of the elements, but also in the existence of a yolk passage. Will, however, shows that in the viviparous Aphis there exists also a yolk passage, and that the arrangement of the cells in the interior of the chamber is quite the same as that in the true females, and the elements he considers as vitelligenous cells. The wall of the fully developed ovarian tube of the adult is formed of a single layer of epithelial cells, which not only covers the egg chamber but also the terminal one. Nothing was seen of the structureless tunica propria mentioned by former writers on the subject, although he used in his investigations one of Zeiss's homogeneous immersion lenses.

[1] *Bulletin No. 5 of the Illinois State Laboratory of Natural History.* Feb., 1889. pp. 66.

[2] *Zur Bildung des Eies und des Blastoderm bei den Viviparen Aphiden.* LUDWIG WILL. Aus den Arbeiten d. zool. zoot. Instituts in Wurzburg, Bd. VI.

The terminal chamber, in which the egg is formed, consists of two parts. The wall of the upper part is formed of pavement epithelium, which is continued into the solid interior part. In the interior of the upper part he finds a rounded mass of protoplasm, and between this and the external layer of pavement epithelial cells is a single layer of large cells (the ovula). These cells are each connected with the internal mass by a pedicel of homogeneous protoplasm. The pavement epithelial cells pass into long cylindrical cells at the inferior part of the terminal chamber; this part of the terminal chamber contains, as a rule, only one large cell, the young egg, which is also connected with the central mass of protoplasm by a pedicel.

In the oviparous Aphis, in which a similar structure of the terminal chamber is well known, the cells of the upper part of this chamber have been generally taken for vitelligenous cells, one cell in the lower part for the egg and the pedicel for a passage for vitellus prepared by the vitelligenous cells.

Will shows, however, that at least in the agamic Aphis the elements have quite a different signification. He considers the cells in the upper to be ovula (eianlagen), and the large cell in the lower part a young egg.

The pedicel has nothing to do with a yolk passage, but only corresponds to the pedicels of the ovula.

When one of the ovula has reached a certain size it leaves the upper part of the chamber, but the pedicel remains and forms later that which the authors have called the yolk pedicel (dotterstrang); this remains until the blastoderm is developed. So we often find as many as three successive eggs in connection with the terminal chamber.

On the way downward the egg continually grows, and the cells of the epithelial covering becoming more and more depressed; the ovula do not increase in size at all.

Here two very interesting questions arise: (1) Why does one of the ovula of the terminal chamber leave its place and become a young egg? (2) Why do the eggs and not the ovula increase in size?

(1) At the time when no ovulum has yet left the terminal chamber, and when all the elements of this part of the ovary are of the same size, all the cells necessarily assimilate and grow in the same way. There is no reason at all why they should not, for the ovula are all of the same size and age, and besides this they are all equally near the walls of the chamber and receive an equal supply of nourishment from the blood which bathes the exterior wall of the chamber. The cells grow equally, and exert a great pressure in the wall of the chamber, and the result must be a bursting of the wall of the chamber or a protrusion of one of the ovula into the chamber below. At the base of the chamber, where it passes into the oviduct, the resistance is much less

than that at any other point, consequently the ovulum at this point passes out, drawing with it the pedicel of protoplasm which still remains in connection with the central mass, which Will calls the "*rachis*," and which corresponds to the rachis in the *nematodes*. The ovules have now a chance to grow again, and when the pressure is again exerted another passes out.

(2) In a similar way the growth of the young egg is explained. The ovula as well as the young eggs being connected with the rachis by a string of protoplasm they cannot be considered as distinct cells, for it must be considered that the protoplasm is common to all the cells. It is evident that the new protoplasm which the egg and ovula acquire by a process of assimilation is common as well. The pressure exerted upon the epithelial layer of the egg is not as great as that upon the wall of the terminal chamber and consequently there is much less pressure on the egg than on the ovula. Owing to the great pressure on the ovula, the growth is not so rapid as in the egg, consequently much of the common protoplasm of the terminal chamber goes for the nourishment of the egg through its pedicel.

The cells of the terminal chamber not being vitelligenous cells but ovula, the pedicel is consequently not for the passage of yolk but protoplasm.

II. Formation of the Blastoderm.—The young egg, which possesses no membrane at all, consists of a very homogeneous protoplasm. The clear germinal vesicle (keimbläschen) does not take any color in carmine, while the dense germinal spot (keimfleck) takes a deep stain.

By examining large numbers of eggs in the first stages of development Will finds that the germinal vesicle does not disappear. The first change consists in the appearance of a great number of little vesicles of deutoplasm which are quite different from the later fully developed deutoplasm called by Metschnikoff "secondärer dotter." These vesicles fill up the whole protoplasm with the exception only of that near the periphery of the egg and that which immediately surrounds the germinal vesicle which is really not surrounded by deutoplasm but lies in an irregular layer of protoplasm. In section he found the primitive nuclei in different stages of division, so that the nuclei of the future cells are derived directly from the germinal vesicle. After division of the germinal vesicle, each part becomes surrounded by a layer of protoplasm, and passes to the peripheral protoplasmic layer, where they undergo division and form the future cells of the blastoderm. The blastoderm consists of a single layer of cells which possess a common protoplasm and only later do they become separate. The blastoderm does not cover the whole surface of the egg, for at one pole (the basal), the deutoplasm extends to the surface of the egg.

Will differs considerably from A. Brandt as regards cell divis-

ion, and considers him wrong in a number of other points. He describes a division which is only known in Actinosphærum, where it was described some time ago by Grube.

The principal thing is that it begins with a change in the nucleolus, which breaks up into a great many little particles. These particles are arranged in a definite way so as to form different figures, of which the rod-like form (stäbchenform) is the most common and characteristic. The substance of the nucleus is not modified at all, and only its exterior form is changed. From a spherical vessel it changes to an elliptical, and then into a biscuit-shaped body, after which stage the division takes place.

Will also criticises the "keimbläschentheorie" of A. Brandt, where Brandt considers the germinal vesicle a cell. The theory is based on the idea that the germinal vesicle equals the epithelial as well as the blastodermic cells. Will finds that this basis is false and consequently the theory built upon it is also false.—*B. Sharp.*

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA AND THE ASIATIC ISLANDS.—Mr. C. Trotter's paper upon New Guinea, read before the British Association, contains much general information. Geologically this large island is nearly related to Australia, its separation from which is probably not earlier than the Lower Miocene. West of the Gulf of Papua the ground is low and swampy, with isolated hills which probably were once islands. Westwards as far as Princess Marianne island the sea is so shallow and the coast so low that nothing is visible from shipboard. Here a great submarine bank extends to the Aru islands. The west and north coasts are mainly precipitous—the cliffs frequently of recent limestone, with raised coral beaches—broken by considerable rivers, with flat mangrove-covered banks, affording access to the interior. Except at these spots the densely wooded mountains make access very difficult. The north coasts are almost free from reefs, but the south coast is skirted by one

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

at a distance of five or six miles, thus forming safe anchorages. The interior here consists of ranges of rolling grassy hills with scattered eucalyptus, acacia, etc., interspersed with streams, and contains tracts well fitted for sugar and other tropical crops. Beyond is the Owen Stanley range 13,000 feet high. The rocks of this range appear to be the same as the Devonian and Silurian series of the New South Wales gold-fields. The central mountains of the northwest peninsula, the Arfak, seem mainly granite and gneiss. Though severe earthquakes occur on the north coast, no active volcanoes have yet been found.

The level of civilization among the isolated tribes of Papuans varies greatly. Some are skillful and industrious cultivators, but their plants and their agriculture appear to have come from Asia. Cannibalism is not common, and is, perhaps, mainly confined to war time. The spirit of the dead ancestor is supposed to enter into his image or Karwar, so that a man would rather part with the skull than with the image of his father. This ancestor worship is the principal part of their religion. They show a marked feeling for art in the ornamentation of their houses, weapons, tools, etc. They are a rude, boisterous, independent people, with a keen sense of their rights, not only in the soil, but in the fruits of the forest trees, and in the fish of the streams belonging to the tribe. Though the Malay custom of building the houses on piles is general, some are also built on the ground, or high up in trees.

The eastern peninsula is partly occupied by a fairer and milder race, with Polynesian affinities, but with a religion even more rudimentary than the Papuan. The people of the north coast generally are finer than those of the south, perhaps through intercourse and intermingling with the emigration passing from Asia to the Pacific, while the people of the south coast have had relations mainly with the inferior Australians. Hereditary rank is not a Papuan conception, and the power of the chiefs is small.

The Malay rulers of the small islands Bachian, Gébé and Tidore have, since the fifteenth century, laid claim to New Guinea. The Dutch base their claims on those of the last, as their suzerainty, and have annexed the western part as far as 140° 47′ E. long. New Guinea was actually discovered by the Portuguese or Spaniards in 1526–8, and by the time of Torres most of the outline was roughly known.

The Southern Chinese.—It would seem, from the facts brought together in a paper read before the British Association by Mr. H. S. Hallett, that the claim of the Chinese Emperor to the suzerainty of Tonquin and Annam may be regarded as the revival of a once real, though now obsolete right.

The Chinese Emperor Yaou, who came to the throne B. C. 2356, sent the tribe of Hi to take possession of the country to the south of the Yangtsi. Kingdoms thus formed extended south of Tonquin, B. C. 2208. The Annamite and Shan kingdoms were

in existence within the bounds of the Chinese empire before its earliest contraction. By B. C. 1550, owing to revolts, it had contracted to the northern bank of the Yangtsi-Kiang, and during the Chou dynasty, B. C. 1134–255, it seldom included any portion of the basin of that river. The elder brother of the founder of the Chou dynasty left the empire, and founded the kingdoms of Youe and Hou outside of it, on the frontiers of Ssu-ch'uan. Other evidence leads to the conviction that the Shans formed part of the early Chinese horde. Thirty per cent of their vocabulary is Chinese. The Lao Shans were settled in the country west of Tong-king at a very early date, and had wedged themselves into the Yun country, as far south as Vien Chang, before the arrival of the Yun Shans in the valley of the Menam. The name given to them by their neighbors, Lau or Lao, means ancient or old. The Yun Shans had founded towns south of Yunnan long before the time of Gaudama, and were pushing down the valley of the Mekong through the Yun or Karen country. These Karens, there is reason to believe, were the earliest Chinese emigrants, for a long period they ruled over the country of Youe-Chang (Tchen-Tching, Lin-y, or Lam-ap), and in the fourth century over Cambodia. In A. D. 431 the Yun Shans founded several cities in the valley of the Menam, and by 707 had overrun and occupied the northern half of Cambodia.

Early in the sixth century B. C., the Mau Shans entered the valley of the Irrawadi, and drove the Burmese tribes to the southward. About A. D. 1220 they annexed Assam, and became predominant over the Shan States east and west of the Salween as far south as Zimmé. By the end of the thirteenth century they had shattered the Burmese empire, driven the Yun Shans to Chaliang, from whence the latter descended and founded the kingdom of Siam, attacked Java, Malacca and Cambodia, annexed part of Pegu, and extended their sway over the Malay Peninsula as far south as Lavoy. From this time to 1554, Shan princes ruled in the valleys of the Irrawadi, Sittang and Salween, as well as in the country south of Yunnan, as far east as Cochin China.

Anam, or Upper Cochin China.—According to M. Labarthe (*Rev. de Geographie*, Sept., 1883), Anam is but a strip of hilly uncultivated country lying between the ocean and mountains that border the basin of the Mekong. Unhealthy, and scarcely capable of producing rice enough for its inhabitants, it is entirely dependent upon the supplies and finances drawn from Lower Cochin China and Tong-king. The loss of the former is a severe blow, that of the latter will be the fall of the Anamite power. The most fertile portion is the province of Binh-dinh, midway between Saigon and Hue, the ancient stronghold of the once powerful Tsiampas, who for ten centuries kept the Anamites in check. In this province there are more than five hundred villages and fifty

or sixty markets. The capital and citadel of Binh-dinh may have ten to twelve thousand inhabitants. Near it is the port of Thi-nai, the ancient Gia, by error called Qui-nhon on the French maps. The area of Anam is probably about 47,000 square miles. The capital, Hue, was created by the Anamite Emperor Nguyen-Anh. It has a huge citadel, but the town, according to M. Aubry, does not contain more than 40,000 people.

AFRICA.—Mr. J. Stewart has made important geographical discoveries in the upland region between Lakes Nyassa and Tanganyika. On an expedition westward to Mt. Mapurumuka, he passed in two days march the affluents of the Songwé, flowing to Lake Nyassa, the Loangwa flowing to the Zambesi, and the Chambezi flowing to Lake Bangweolo. The source streams of Chambezi were found to be 934 feet above the lake, and form a considerable river by their union. Further along the road to Tanganyika other streams flowing to the Chambezi were found at a level of 500 to 600 feet above the lake, so it is inferred that a portion of the lower course of the river is navigable.

Mr. J. T. Last (Proc. Roy. Geog. Soc., Oct.) gives a graphic description of the tribe, or rather the remnant of a tribe, known as the Wa-itumba. The coast tribes (Warima) assisted by the Wa-lori, overran the whole of the district formerly inhabited by the Wa-itumba, so the Humba and Mamboia mountains are now but very thinly settled, though numerous sites of decayed villages, with their plantain-trees, remain to tell the tale. The Humba hills consists of five ranges lying between 6° 30′ and 7° S. lat. and 36° 30′ and 37° E. long. The hills have few trees, but are covered with tall coarse grass, while between each range is a valley with one or more rivers fed by numerous streams. The Wa-itumba are tolerably tall, and of muscular build, owing probably to their work as iron-smelters and forgers. They are far superior to the surrounding agricultural tribes in acuteness, ingenuity and barter, and in appearance have very much in common with the sooty foundrymen and blacksmiths of more civilized communities. The ore is found in three places between the third and fourth ranges of hills, and is obtained from a layer of red clayey sand by washing away the light sand in a successive series of pits, and then by fanning so as to separate the small stones from the heavier particles of iron ore. The sand probably contains five per cent of ore. This part of the work is usually performed by the women. The clayey sand is obtained about two feet below the ground. The smelting is done with charcoal, made by the men for the purpose, and is carried on in a pit. To keep up the blast, bellows are made of wood and skin, with a wooden tube; and clay pipes, moulded on a bamboo about two and a half inches in diameter and five feet long, are used to convey the blast to the furnace. The fire is fed alternately with charcoal, and ore, and three sets of bellows

are used. The result is a mass of impure iron, which has to be again smelted to consume the charcoal within it, and is then heated again and hammered into hoes. The smelting is done in a round hut with a steep high roof, but all the blacksmith's work is done in the open air. The neighboring Mangaheri are a timid, peaceable people inhabiting a district some thirty-five miles long by fifteen wide between 6° 20′ and 6° 40′ S. lat. and 37° to 37° 40′ E. long. Every man is more or less a blacksmith and can forge hoes, swords, hatchets, arrow-heads, spears, etc. The women do most of the gardening, but men do the rougher bush-cutting, and join in the harvest. After harvest, much *pombe* or beer is drank. Two yards of calico is the usual dress of both sexes. The houses of these tribes are of two kinds, *misongi* or round huts, and the more substantial but dismal and dirty *tembe*. A tembe consists of crotched posts inserted in holes about two feet apart. Two rows of these posts are set up at a distance of about nine feet from each other, a pole is laid along the crotches of each row to serve as wall-plate, and the two rows of posts are connected by poles from wall-plate to wall-plate. The space between the posts are filled in with small wood, bound with a wild creeper, and packed with wet clay. The roof is made by covering a mass of smaller posts, branches and grass with about two feet of dry beaten clay. A doorway never more than four feet high and two wide and some small round holes to look out at, are left in the sides.

Mr. Stanley returned in August from a journey to the mouth of the Ikelemba or Kassai, where he founded an advance station. Lieut. de Brazza's expedition is said to be at a standstill on the Upper Ogowé. By the upsetting of a canoe while crossing the Congo at Msuata, Lieut. Jansen and the Abbè Guyot were drowned, together with eight of their eleven Zanzibar men.

The African traveler, Ernst Marno, died at Fazogi, on the 17th of August last, while on his way to Europe to recruit his health. He was only 39 years of age.

GEOGRAPHICAL NEWS.—An expedition despatched to New Guinea by the proprietors of the Melbourne *Argus* has returned to Queensland. Its members suffered from fever, and one, Professor Denton, died.——Dr. Fisher, when about six days march from the semi-mythical inland sea of Lake Bahringo, was compelled to return by a force of 3000 Masai warriors. He has made large collections, including many species new to science.——Capt. C. E. Foot, R. N., has been appointed British Consul for the Lake district of South Central Africa, and will endeavor to enter into friendly negotiations with the native chiefs.——M. Flegel is preparing to travel from Abudja, near Onicha on the Niger, via Adamawa, to the Congo, and Lieut. Wissman has been engaged by the International African Association to command a new expedition in the basin of the Congo.——The Italian traveler, Sac-

coni, sent out by the Milan Geographical Society, was murdered by the Somalis on August 5th. The Sultan of Ogaden had warned him not to proceed on account of the state of war that prevailed, but Sr. Sacconi continued onward until he was surrounded by 5000 men. In the course of the night five Somalis suddenly attacked the traveler's tent while the guards were asleep and killed Sr. Sacconi with their knives. All his notes are lost, and his diary burned.——Captain Dawson and party, of the British Circumpolar Expedition, which wintered at Fort Rae, arrived safe and well at Winnepeg on Nov. 2.——Lieut. Hovgaard, in reply to an inquiry from Baron Nordenskjöld, states that he could have navigated the Kara sea and reached the Yenisei last year had he not, by signals of distress from the *Varna*, been compelled to leave the lead along the shore of Waigatz island. The lead was open as far as the eye could reach.——In the vicinity of Bona, Algeria, the Naiba, an isolated mountain 800 meters high, is gradually descending into the earth, forming a deep excavation round the sinking mass.

GEOLOGY AND PALÆONTOLOGY.

Results of the Deep-sea work of the "Talisman."—M. Alphonse Milne-Edwards has communicated to the French Academy some preliminary reports of the results of the work of the deep-sea explorations conducted by the French government during the past season. The work was carried on from the Gulf of Gascony to the Cape Verde islands, and then north-westward to the Sargassum sea, north-eastward to the Azores, and back to France. As far south as the exploration extended, the great depths were found to be occupied by an arctic fauna, totally distinct in character from that inhabiting the lesser depths. The difference, says M. Milne-Edwards, is like that distinguishing the faunæ of distinct geological horizons. Between the Azores and France the bottom is covered with deep white slime composed of the shells of Globigerina. Fragments of pumice and other rocks ar mon, some of the latter containing fossils, among others T es. There were also found, 700 miles from the coast of Fr polished and striated pebbles of glacial origin, which M. M dwards thinks were dropped there by icebergs.

discoveries show how transpositions of faunæ which pre- rent chronological characters, such as the occurrence of colonies, may take place. Oscillations of the ocean beg on a sufficient scale are all that is necessary. Elevati ocean bottom sufficient to connect New Guinea with Cele Borneo, would give the same result, a Mesozoic or Eoce ammalian fauna would supervene on a modern one. The on of North America during the Pliocene period by the S American Edentata, was a case of an inferior fauna succe a superior one.—*E. D. Cope.*

THE EOCENE FAUNA OF PATAGONIA.—In a recent issue of the *Revue Scientifique* M. Trouessart gives an account of the Eocene fauna of Southern Patagonia. The great discoverer in this direction has been Señor F. P. Moreno, of the Buenos Ayres Museum, who, with five persons and a canoe drawn by horses, ascended the Santa Cruz river beyond the point reached by Darwin, and discovered lakes Argentine, Viedma and San Martin, all fed by the glaciers of the Andes. The middle course of the river, though desolate as the lower, is grander, and the outlines of the hills at once reminded Sr. Moreno of the *Mauvaises Terres* of Nebraska and New Mexico. The upper course traverses the great forest of beeches that has replaced the palms of the Tertiary epoch, and the richness of the flora contrasts greatly with the aridity of the lower regions. In a little cavern was found the mummified body of a man, wrapped in feathers of the rhea and painted like the mummies of Arizona. This mummy marks the previous existence of a people less barbarous than the scattered tribes that now inhabit the country.

On the left bank of the middle course, at a point passed but not noticed by Darwin, was discovered the rich fossiliferous beds, the treasures of which now enrich the Museum of Buenos Ayres. The current is so rapid and the stream so narrow at the passage of this formation, the beds of which are almost vertical, that it is no wonder that Darwin's attention was otherwise occupied when passing. These difficulties caused the collections made by Sr. Moreno to be far smaller than they would otherwise have been.

One of the principal remains is a large skull, incomplete anteriorly; this skull was described under the name of *Astrapotherium patagonicum* by Burmeister. According to Señor Moreno the upper surface is convex; there are no horns, and while enormous canines are present, there are but three or four molars or premolars on each side of the upper jaw. It presents very generalized characters, its only molar is marsupial, while the form of the skull approaches that of the carnivores, so that it may be supposed to be a great transitional marsupial of aquatic habits. The brain is very much reduced. Another species is a true marsupial which Sr. Moreno has described under the name of *Palæotenthes aratæ*. The same locality has furnished a portion of the mandible of Owen's *Nesodon imbricatus*, and two molars of *Toxodon patagoniensis*, both from a more modern horizon than Astrapotherium. In the same bed with Toxodon, Sr. Moreno has found also the skulls of two smaller animals, which together constitute a complete transition between the toxodonts and the rodents. One of these is named *Toxodontophanus australis*, while the other, nearer to the rodents, is styled *Interatherium rodens*.

Tembotherium holmbergii is a true rodent from the Santa Cruz beds. M. Lista, in his voyage to the sources of the River Chico,

had previously found a cranium of an Anchitherium, as well as of Nesodon. Dr. Cunningham had discovered in the Lower Tertiary of the Gallegos river an ungulate described by Flower as *Homalodontherium cunninghamii*, and d'Orbigny had found the rodent-like *Megamys patagoniensis*. Two molars, with a fragment of skull, discovered by M. Moyzes in a bed which is believed by Sr. Moreno to form the passage from Cretaceous to Tertiary, might have belonged either to a gigantic capybara or a small elephant, and formed part of what is probably the oldest known South American mammal. Sr. Moreno has named it *Mesotherium marshii*.

Dr. Cunningham was the first to find remains of Edentata in the Tertiary, by the discovery of some plates of a Glyptodon on the Gallegos river. In the upper horizon of the Santa Cruz beds Sr. Moreno has found fragments of the cuirass of *Hoplophorus australis*, and the Museum of Buenos Ayres has the humerus of a Mylodon from a Tertiary deposit near the Rio Colorado.

In the Bay of Santa Cruz, at the base of the marine Tertiary, Sr. Moreno found the skull of an enormous cetacean so firmly imbedded in the rock that he could only extricate the cervical vertebræ and a portion of the occipital region. This species he has named *Palæobalæna bergii*. Remains of another cetacean species, *Saurocetes argentinensis*, were also found, as well as fragments of some dolphins, of some seals from the Chubut river, and of birds, etc. The discovery of these remains tends to show that the Tertiary fauna of Patagonia preceded that of the Argentine Republic, and if the list of the Patagonian Tertiary fauna is small, it is probably because it is as yet incomplete.

It was previously supposed, on the faith of the observations of d'Orbigny, Burmeister and Darwin, that Patagonia was entirely composed of marine Tertiary deposits, but it is now demonstrated that terrestrial and lacustrine deposits are largely represented.

The presence of so rich a Tertiary fauna in Patagonia lends weight to Sr. Moreno's opinion that at the commencement of this period a southern continent existed, spreading over the present bed of the Atlantic and Pacific, and that the fauna of this country spread northward towards the equator at the time when the glacial epoch had set in in Southern Patagonia. Traces of local emersions and immersions, as well as traces of an abundant vegetation advancing to the sea, occur in many points of Patagonia, which at that period evidently enjoyed a warmer climate. At the present time the southern point of the South American continent appears to be slowly sinking, and soundings in the Atlantic show that a rise of less than 150 meters would unite the Falkland isles and Tierra del Fuego with the continent, which would then, at the latitude of the Santa Cruz river, have the width of Africa at Orange river. A further rise of 2000 meters would unite this land with South Georgia and other antarctic lands, and the kind

of hook towards the east formed by Tierra del Fuego and Staten island, indicates the direction of the crest of this submerged continent. This subsidence of Patagonia, following an elevation which has left salt lakes with still-living marine species 200 feet above the sea, is balanced by an elevation to the north of the Rio de la Plata. There the same upward movement of submarine formations which has caused the canal to the east of the Patagonian Andes to be abandoned by the sea, while that to the west parts off a chain of multitudinous islands, is now in operation farther north. Modern alluvium, formed by great lakes fed by the melting glaciers, have filled up the old sea-canal to the east of the Patagonian Andes. An alternation of partial subsidences and elevations, such as are now acting, allowed the fauna to persist, and caused that alternation of marine and terrestrial beds which is observable.

Towards the middle of the Tertiary period, the two Americas were as yet disunited, Southern Brazil was a great island, the ocean filling the basins of the Amazons and the La Plata; the mass of the Columbian mountains stretched to the north, while Bolivia and Patagonia, now separated from the southern continent, formed a vast peninsula. The numerous groups of islands dotted over the Pacific seem to be the remains of the submerged continent which united Australia to South America. According to Hooker, not less than seventy-seven species of plants are common to New Zealand, Tasmania and South America, whilst very few cosmopolitan genera are common to these regions. The presence of marsupials is another link between Australia and South America.

Probably Australia was parted off at the end of the secondary period, while South America was still a portion of the southern continent. The marsupials were thus divided and evolved separately in their two seats, while in the Miocene the edentates appeared in Patagonia.

The red sandstone, probably Cretaceous, which occurs in the triangle formed by the rivers Limay and Neuquen, and contains the remains of Mesotherium, is probably the oldest formation known in Patagonia, and extends over a large area to the south and south-west. An ancient shore near Lake Argentine proves the subsidence of Patagonia toward the end of the Tertiary period.

Sr. Moreno believes that the present relief of Patagonia is the result of volcanic eruptions which, towards the end of the Tertiary, were repeated from Tierra del Fuego to Brazil. Under the influence of these Patagonia rose again, but the antarctic ice had advanced and the land was glaciated. The pampean formation is the result of the far-spreading glaciation produced, in Sr. Moreno's opinion, by astronomical causes, and the remains found in it were carried by the ice from more southern parts—not a single complete skeleton is found in the true silt of the lower pampean.

The cold spread northwards to Chili, Bolivia, even Brazil, and most of the animals perished. A few of the hardiest, as the guanaco, llama, vizcacha, puma, armadillo and rhea again spread southwards when the glacial era passed, but the great edentates found neither the mild climate nor the abundant vegetation that suited them, and remained in the as yet marshy pampa. At this epoch the mastodons which had penetrated by the Isthmus of Panama, appeared upon the scene. The extinct fauna found in Patagonia must be that indigenous to the country, for since no animal leaves its country unless forced thereto by the struggle for life, it is unlikely that Brazil and Bolivia were abandoned for desolate Patagonia.—*Dr. Trouessart in Revue Scientifique.*

Schlosser on Anoplotherium.—Herr Schlosser, of Munich, has dispelled the uncertainty respecting the relations of the genera Anoplotherium and Eurytherium. He finds that the peculiar second digit of the hind foot which characterizes the latter, belongs as well to the former, and that the name Eurytherium is a synonym. This digit, extending nearly at right angles to the others, was probably connected with them by a web, according to Schlosser, who agrees with Cuvier that the habits of these animals were aquatic. He refers three genera to the Anoplotheriidæ, with the following numbers of species. Anoplotherium Cuv., three sp.; Diplobune Fraas, three sp ; Dacrytherium Filh., one sp.

Elevated Coral Reefs of Cuba.—Mr. W. O. Crosby (Proc. Bost. Soc. Nat. Hist.) describes the elevated coral reefs of Cuba, and from them draws inferences adverse to those drawn by Professor A. Agassiz from examination of the Florida reefs. Four coral terraces extend, with slight interruptions, round the entire Island of Cuba. In the western part of the island they are the predominating formation, and are well preserved on the summits of the highest hills, but further east erosion has been more rapid. The lowest terrace, on the northern side of the island, rises thirty feet, the second rises abruptly 200 to 250 feet above it, the third is about 500 feet high, and the fourth has a height of probably not less than 800 feet near Baracoa. Five miles west of Baracoa 1000 feet of the upper part of a mountain is reef limestone and originally the formation must have been 2000 feet thick. The thickness of the reefs here and upon the Island of Jamaica, where the elevated reefs reach a thickness of 2000 feet, is considered by Mr. Crosby to prove that they were formed in shallow water during a period of slow subsidence, according to the theory of Darwin.

There does not appear to be any reason to doubt Mr. Crosby's conclusions in this case, neither does there appear to be any reason to doubt those of Professor Agassiz in that of the Florida reefs. The latter authority does not endeavor to set aside the

theory of Darwin, but to show that in some cases, at least, coral reefs are but the summit of an elevation formed by other agencies. In cases of subsidence the reefs are thick, while in regions of elevation, as in Florida, the coral reef is but a thin crust topping a bank of deposited matter.

MINERALOGY[1].

GRODDECKITE—A NEW ZEOLITE.—A. Arzuni describes a zeolite from St. Andreasberg, in the Harz, which, while closely resembling gruelinite in form and physical properties, contains iron and magnesia in place of pativis of the aluminum and lime, and is to be regarded as a new variety of gruelinite. It is described as occurring in small crystals upon calcite, containing in their form the rhombohedron, scaleushedron and hexagonal prism, and possessing a prismatic cleavage, and a hardness of between 3 and 4. The composition is:

SO_2	Al_2O_3	F_2O_3	CaO	MgO	Na_2O	H_2O (by difference)	
51.2	12.0	7.7	1.1	3.8	4.5	20.2	= 100

and the formula

$$(Mg\ Na_2)_2\ (Al_2\ Fe_2)_2\ S_9\ O_{26} + 13\ H_2O$$

is adduced, the mineral being regarded as a magnesia-iron gruelinite.

It is named from Dr. A. von Groddeck, the director of the museum at Clausthal, in which the specimen was found.

HERDERITE FROM MAINE.—Mr. U. E. Hidden, well known for his mineralogical discoveries in North Carolina, announces[2] the probable occurrence of the rare mineral Herderite at Stoneham, Maine. The crystals are short, truncated prisms, transparent to translucent, colorless or faintly yellowish. Hardness 5, sp. gravity 3. The crystals are orthorhombic with $I \lambda I = 116°$ It resembles topaz in form and color, but has neither the cleavage nor the hardness of that mineral. An analysis is now being made. Professor E. S. Dana gives some crystallographic measurements which closely approximate the angles of herderite.

RECENT METEORITES.—A large meteorite fell last February near Brescia, Italy. It was about half a metre long and of a conical shape. It buried itself a metre deep in the earth, singeing the grass in the neighborhood, and when dug out was still warm, and the smell of sulphur was distinctly noticeable. Although the meteorite passed through the air in a S. S. E. direction, it forced its way into the earth obliquely in an opposite direction.

About a year earlier, in February, 1882, a great meteor burst in a cloudless sky in Transylvania. A large ball of fire seen through-

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Am. Jour. Sci.*, Jan., 1884, p. 73.

out western Transylvania suddenly burst, and three minutes after its disappearance a series of detonations was heard. The path of the meteor was for a long time marked by a grayish-white cloud. Some 3000 stones fell, the largest of them weighing over 38 kilogrammes. Analysis showed that they were stone meteorites containing a percentage of 9.88 nickel-iron, 6.63 magnetic pyrites and 83.49 silicates.

THE FELDSPARS.—Speaking of the importance of a correct determination of the feldspars, J. Szabo[1] remarks "that it is the unanimous conviction with petrographers that every kind of a rock mass can be best determined by the mineral association found in it, and of all mineral it is the kind of feldspar which is most important. There was a time when we had been contented to say feldspar generally; then came a time when we said orthoclase and plagioclase; but now we know that this is not enough; we must discern among the plagioclases according to their basicity, at least an oligoclase-andesite, a labradorite, and a bytainite-anorthite." He states that in the case of an eruption, the most acid feldspars are the first product of eruption and the most basic the last, and that in many cases "the determination of the feldspar is the only possible way of saying something of the lithological and chronological character of the rock in question."

In order to determine the feldspar in the quickest way, he recommends flame experiments, and describes his method of work. It is based upon the coloration of the flame of a Bunsen burner by potash and sodium, and upon the degree of fusibility of the different feldspars, both being observed in the same experiment. A grain of feldspar of the size of a mustard seed is placed upon a loop of very thin platinum wire, and introduced into different parts of the flame. He distinguishes *seven* degrees of fusibility from Bronzite (1) to Stibrite (7), in each case holding the grain in the flame for one minute, and noting the degree of fusion. "Sodium is the element in the silicates which makes them easily fusible, the magnesium and aluminum render them less fusible or altogether infusible."

As to the coloration of the flame, he uses a solution of indigo in sulphuric acid, through which to observe the coloration by potash, and discovers five degrees in the yellow flame of sodium, and three degrees for the red flame of potash, the intensity of coloration depending upon the percentage of the alkali.

By combining these observations with an examination of the character of the fused globule, it is claimed that all the principal feldspars can be racognized. It is doubtful, however, whether a careful lithologist, unless made confident by long practice, would be sure of his determination by this method. The almost universal occurrence of a mixture of two or more feldspars renders any

[1] Proc. Amer. Assoc. Adv. Sci., XXXI., 270, 1882.

such method uncertain. Descloiseaux, in a recent paper,[1] has shown that although albite is the most constant of all the feldspars, it is subject to great variations, both as to homogeneity and optical characters.

Tschermak holds that the soda-lime feldspars are all mixtures of a soda feldspar with a lime feldspar, the proportions varying to form a continuous series from a pure soda feldspar (albite) to a pure lime feldspar (anorthite). Probably the only perfectly pure albite ever found occurs at Kasbék, Caucasia, where, according to Baerwald,[2] is a feldspar in which is no trace of lime or potash, and whose angles and specific gravity are almost identical with those calculated by Tschermak as belonging to a theoretically pure albite.

PSEUDO-SYMMETRY.—In the new edition of Pisani's excellent "Traité élémentaire de Mineralogie," the subject of pseudo-symmetry is treated substantially as follows: After referring to the labors of mineralogists by means of the polarizing microscope upon the internal structure of certain minerals, such as analcime, boracite, some garnets, etc., generally regarded as isometric, but shown optically to belong to another system; and after referring to similar researches upon crystals of the tetragonal, hexagonal and orthorhombic systems, such as idoclase, certain corundums, etc., which have led to the conclusion that the exterior envelope of all these crystals is the result of the grouping of interior polyhedrons arranged geometrically around a point; he remarks that these phenomena may be explained in most cases by an interior molecular transformation taking place *after* the formation of the crystal.

He states that it is only certain garnets from particular localities that have an anomalous structure, and that it is a singular fact that in no case does the external shape of pseudo-symmetrical crystals approach the form indicated by their interior system.

While admitting that the interior structure of a crystal may indicate another crystalline system than that generally admitted, Pisani recommends that each species should be placed in the system indicated by its *geometrical* form, at least until some more convincing proof to the contrary has been adduced.

MINERALOGICAL NOTES.—A new locality for topaz has been discovered near Platte mountain, Colorado, about twenty-five miles north of Pike's Peak. The crystals occurred in a pocket in decomposed albite. The topaz is either colorless or has a pale straw-color. Some of the fragments found indicated from their size the occurence of very large crystals. Associated with the topaz were crystals of microcline, gœthite, fluorite, etc. The largest microcline crystal found measured eighteen inches in the

[1] Bull. Soc. Min. de France, VI, 89.

[2] Zeitsch. f. Kryst., VIII., 48.

largest diameter.——E. Claassen has described some interesting crystals of pyrite from Parma, Cuyahoga county, Ohio. They form combinations of the cube, octahedron and pyritohedron, the cube predominating. The interesting feature of the crystals consists in the fact that the cubic planes are *concave*, the other faces being flat as usual. Some of the combination edges are therefore curved lines. The author supposes that the concave planes are the result of subsequent growth over a smaller normal crystal. It is more probable, however, that the raised edges are due to the more active growth which always occurs at the edges of planes, and which renders the edge harder than central parts of the planes. In quartz crystals the edge is often raised above the interior, and the same occurs in imperfect crystals of alum, salt, etc. The edges are first formed, and if the solution is exhausted, the planes are very apt to be concave.——Kosmann has published a description of the minerals of the ore deposits of the Muschelkalk of Upper Silesia. In addition to the various ores of zinc and manganese which are described at length, mention is made of an interesting discovery of a bed of asphalt in the deep workings of the Friederich's mine.——Now that asbestos in the many forms in which it is manufactured, is so largely used in mines, factories, furnaces, mills, steamships, etc., the demand for the raw material is great. Asbestos suitable for manufacturing purposes is not common. Even though the mineral may look well to a mineralogist, it may be worthless to the manufacturer. Not only is length of fiber necessary, but a certain toughness and elasticity is requisite, which many specimens do not possess. If it is at all altered or "rotten," it is without value.——Larger quantities of horn silver occur in Arizona, the ore being horn silver and native silver occurring in syenitic gneiss. Many mines have been opened, and many millions of dollars of silver already extracted. In a mine recently opened in the Turkey Creek district, $60,000 worth of silver was obtained in the first fifty feet sunk. Argentiferous sulphuret of copper has been discovered in Yavapai county, yielding copper and silver in abundance.——Rubellan has been shown by Hollrung to be an alterative product of magnesian micas, very variable in composition, by no means homogeneous, and certainly not entitled to a distinct name.——The Zircons found near Pike's Peak, Colorado, are very pure and transparent, and are occasionally of a deep emerald-green color.——Geinitz has described a pseudomorph of nacrite after fluorite, in which the nacrite partially filled a crystal of fluorite.——A *chromium diopside* has been found in the diamond mines of the Cape.——The blue color seen in some varieties of halite has been investigated by Wittjen and Prechi, who conclude that it is probably due to the presence of minute gas inclusions, producing the optical effect.——An examination of a boiler incrustation from Zwickau, proved that the main constituent was magnesium hydroxide, or *brucite*.

BOTANY.[1]

POPULAR BOTANY AGAIN.—Some months ago, in commenting upon Step's "Plant Life," we referred to the duty which every scientific man owes to his country, to present the leading facts of his science in the language of the people.

We wish to reiterate the sentiment, feeling that in so doing we are aiding the cause of scientific and technical botany. We hold the more eminent a worker in science becomes, just so much the more is it his duty to appear before the world as an instructor who may speak "as one having authority." The world is full of men who write for the people, but who themselves have not seen the things whereof they speak. That they have readers, shows the longing there is among the people for a knowledge of scientific matters. Why should not every man who brings to light an important fact in any department of science, himself publish it to the world at large, instead of permitting another to do so "who has simply been standing at the door of the temple?"

The wonders of plant life ought to afford material for many a popular book, popular in the best sense of that much abused word. It is greatly to the credit of the people who read popular books, and who listen to popular lectures, that both authors and lecturers find it profitable to assume to have themselves seen the wonderful things of which they speak. There is a hint here for genuine workers, for the men who have all their lives been familiar with Nature's mysterious workings. If the man who makes a hasty excursion into the domain of Nature, and fills up his fragmentary and superficial observations by cramming from some standard volume, is so eagerly listened to, how much the more will he be who is able to draw from long years of personal experience the material of his narration.

Some time ago Miss Herrick prepared a few papers for *Scribner's Monthly* upon some of the curious and interesting things which the microscope had revealed to her in the world of plant life. She has now brought these together and added a few others under the title of "Wonders of Plant Life,"[2] which the Putnam's have brought out in one of the tastiest little volumes which it has been our good fortune to examine for many a day. We have first a chapter on the beginnings of life, in which many things as to protoplasm and plant cells are pleasantly spoken of; then follows a chapter on single-celled green plants, treating principally of diatoms, and a third on fungi and lichens, a fourth on liverworts and mosses, a fifth on ferns. The remaining chapters take up in order the physiology of plants, corn and its congeners, the microscope among the flowers, pitcher plants, and insectivorous plants.

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

[2] The Wonders of Plant Life under the Microscope. By Sophie Bledsoe Herrick. New York, G. P. Putnam's Sons, 1883. 284 pp. 16 mo.

All the way through the author has introduced drawings from specimens of her own preparations, and these, with those copied from Sachs, Carpenter, Darwin and other sources, bring the number of illustrations up to eighty-five. Some of these are quite good, while others, we are sorry to say, are sadly deficient in that very desirable quality—accuracy.

Now this book is one from which, as a text, two separate sermons might be preached. From one standpoint it is to be commended, while from another it must be severely criticised. It is commendable in that the author has wrought into it so much of her own observation and work; it is to be criticised in that there are so many grievous errors which mar what would otherwise have been a delightful little book. We are sorry to have to say it, but there is not a chapter which does not contain erroneous statements. We are all the more sorry to have to say this, because of the evident good faith and desire on the part of the author to represent the several subjects treated of as they are understood by modern botanists. Had the manuscript (and some of the drawings) been submitted to some one more familiar with the subject, many of the errors might have easily been eliminated. For example, on page 73 we read "Mildew, which is so destructive to cotton and linen fabrics, etc., etc.," and we are then referred to "Fig. 20 A." Upon turning to the figure we find a poorly copied drawing of wheat rust (Puccinia)! The blunder, for such it is, comes from the fact that in England wheat rust is called mildew, but our author ought to have known that what she referred to is a very different thing. On page 133 we have an illustration of the truth of the adage "that a little knowledge is a dangerous thing." Here we read that "lateral shoots, vegetable hairs, and leaves are exogenous, or proceed from a layer of growing cells just underneath the bark," a statement which bears evidence of an entire misunderstanding of the term exogenous in this connection. It is needless to cite further examples. May we not hope that the publishers will authorize an early revision, in which the errors will be eliminated?

Genera Pyrenomycetum Schematice delineata. By P. A. Saccardo, Patavii, Nov. 1883.—This latest work of the well-known mycologist of Padua, consists of fourteen lithographic plates, large 8vo, on which are illustrated the 280 genera into which the Pyrenomycetes are divided, according to the system of classification adopted in the two volumes of the Sylloge by the same author. The figures, though not claiming artistic perfection, are very good and answer admirably the purpose for which they were intended. They give in fact "a bird's eye view" of this vast family of fungi and may be considered as indispensable both to the amateur and the critical student of mycology. It is noticeable that in this new arrangement, the name Sphæria, under which

all these forms were once included, has, as far as any generic significance is concerned, entirely disappeared, being retained only to designate the 420 species (enumerated on pp. 367–543, *Syll.*, vol. 2) whose fructification is unknown. Whether this new classification, founded principally on the color and septation of the sporidia, will finally be accepted, remains to be seen. By the mycologists of continental Europe it is already adopted, while the English mycologists, under the leadership of Dr. Cooke, are raising some objections which are worthy of consideration.

The old classification of the Sphæriaceæ has already been essentially modified and is destined yet to undergo still further changes. The only question seems to be concerning the nature and extent of these changes.

In making innovations on any old and well established system, the tendency is always to extremes, and the new definitions proposed are finally accepted, rejected or modified in accordance with the conclusions deduced from more mature deliberation, and this no doubt will be the case with the new carpological system so ably advocated and finely illustrated by the learned editor of the *Sylloge*.

The objections urged against this system are, in brief, that forms evidently closely allied are widely separated. For example, the old genus Melanconis is limited to the species with uniseptate hyaline sporidia and stands in the sect. Hyalodidymæ, while the species with uniseptate brown sporidia constitute the genus Melanconiella in the sect. Phæodidymæ, and the species with brown sporidia having three or more septa are placed in the genus Pseudovalsa in the sect. Phæophragmiæ, the mode of growth in all these three forms being essentially the same, *i. e.*, perithecia more or less distinctly circinate in a definite stroma. It cannot be denied that the carpological system of classification has merits not to be disregarded or hastily rejected, and it is probable that with some modification it will yet be universally adopted. Meanwhile, whatever may be the final conclusion, students of mycology everywhere will be glad that with the two volumes of the *Sylloge* and the "Genera Pyrenomycetum" they may now with reasonable certainty determine the various species of Sphæriaceous fungi within their reach.—*J. B. Ellis, Newfield, N. J., Dec. 10, 1883.*

New Florida Fungi, III.—*Isariopsis clavata*, E. & M.—Bundles of fertile hyphæ about 5^{mm} high and 30–40μ. thick, composed of loosely compacted threads divergent and subundulate above and bearing at their tips single oblong-fusiform brown 3-septate conidia, 18–22 × 5–6 μ. Many of the component threads terminate in free, divergent ends, these free ends also bearing conidia. There is also a prostrate hypha, like that of Meliola, forming orbicular patches from which the upright hyphæ arise. On living leaves of *Persea palustris*.

The above described species were collected at Green Cove Springs, Florida, during the winter of 1882–3, by Dr. Martin.

To these may be added the following species collected at various places:

Phyllosticta fraxini E. & M.—Spots light brown with a dark purple border, ½–1^{cm} in diam., perithecia epiphyllous, scattered, lentiform, black, (150μ); spores oblong, or oblong-elliptical, hyaline, 1–2 nucleate, 7–9 × 2½–3μ. On leaves of Fraxinus, Del. Co. Pa. Dr. Martin; and Bethlehem, Pa., E. A. Rau.

Phyllosticta catalpæ E. & M.—Spots pale brown, circular, 5–7^{mm} diam., border darker; perithecia few scattered, often sterile, brown, lenticular, innate, epiphyllous, 112 × 84μ; spores subhyaline, oval, 5–7 × 2½–4½μ. On leaves of *Catalpa bignonioides.* West Chester, Pa., August, 1883.

Ramularia orontii, E. & M.—Spots large, pale brown, border darker; hyphæ epiphyllous, hyaline, 30 × 3μ, apices mostly bifid; conidia hyaline, numerous, oblong, with the ends rather acute, uniseptate, 18 × 4μ. On leaves of Orontium. Newfield, N. J.

Ramularia andromedæ E. & M.—Hypophyllous, forming dull white orbicular patches about 1^{cm} diam., with a red-brown spot of the same extent on the opposite side of the leaf; hyphæ, simple or branched, continuous, 30–40 × 3μ; conidia oblong or cylindrical, 10–20 × 1½–2μ, continuous or uniseptate. On leaves of *A. racemosa.* Newfield, N. J.

Cercospora perseæ, E. & M.—On reddish-brown irregular-shaped spots ¼–1^{cm} diameter, with a dark but not raised border; hyphæ epiphyllous, densely cæspitose, brown, faintly septate, bent and geniculate above, apices subdenticulate, 55 × 4μ. Conidia slender clavate, 3–4 septate, 100 × 3μ. On leaves of *Persea palustris.*

Cercospora heucheræ E. & M.—Spots brown, mostly round (4–5^{mm}), border obsolete; hyphæ fasciculate, flexuous, light brown, mostly hypophyllous, 30 × 3–4½μ; conidia subhyaline (light straw color), cylindric-clavate, septate, 60–75 × 3μ. On leaves of *Heuchera americana.* Chester Co., Pa.

Macrosporium Martindalei E. & M.—Hypophyllous on pale round spots, ½–¾^{cm} diam. on living leaves of *Magnolia glauca.* Hyphæ erumpent, cæspitose, geniculate, multiseptate, 50–80 × 5; conidia 35–50 × 18–22μ, about 3-septate at first, becoming muriform and dark brown; pedicels 20–50μ long, often wanting. The hyphæ form tufts nearly black, arranged in a circle about 3^{mm} in diameter. Occasionally the fungus appears on the upper side of the leaf. The spots on the upper side of the leaf are much darker with a more distinct border and show a dark discolored speck in the center, in which is often found a small white larva about ⅛ of an inch long, apparently hatched from an egg deposited by some insect, which thus causes the dead spot in the leaf on which the

fungus grows. This curious species was discovered by Mr. Isaac C. Martindale, while on a visit to Newfield, Sept. 23d, 1883.—*J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Laboratory Helps.—About two years ago the German edition of Poulson's little manual, *Botanische Mikrschemie*, made its appearance in this country, and was at once placed upon the list of necessaries in the botanical laboratory. Professor Trelease has rendered an excellent service to botanists by translating the work, adding somewhat to it, and causing it to be published in this country. It appears under the title of Botanical Microchemistry, and is published by the well-known Boston house of Cassino & Co. The scope of the work may be understood from the principal topics noted in the table of contents, viz: Microchemical reagents and their application; mounting media and cements; vegetable substances and the means of recognizing them. It is in substance just the book that every laboratory student has been wanting to have at hand for a long time. We regret that the publishers did not print it upon thinner paper. As it is it will be necessary to break the binding before the book will remain open upon the laboratory table. It should have been printed upon thin paper, with narrow margin and a flexible binding, and we hope that the author, and the many students who will use the work, will make so strong a demand upon the publishers as to compel them to speedily bring out a new edition in the more desirable form.

A New Edition of Cooke's Hand-Book of the British Fungi.—It is with a great deal of pleasure that we welcome the first installment of the new edition of this valuable work. The first edition which was published in 1871, has long been familiar to all students of the fungi, and while it contains much that is antiquated, it still is the only general work available. The Hymenomycetes of the new edition will appear as an appendix to *Grevillea*, so paged as to be bound separately upon its completion.

Botanical Notes.—*Grevillea* for December contains an instructive paper on alkaloids and other substances that have been extracted from Fungi, prepared by C. G. Stewart of St. Thomas's Hospital Chemical Laboratory. We hope to present extracts from this paper at an early day for readers of the Naturalist. ——Another species of Podophyllum (the genus of our common may apple) has just been described by Dr. Hance, in the *Journal of Botany*. It was discovered in the Lo-fau-shau mountains of the province of Canton, China. It has four to five extra-axillary purple isostemonous flowers, and has been named *P. versipelle*. This makes four species of the genus now known, viz: *P. peltatum* of eastern North America; *P. emodi* of the Himalayan region; *P. pleianthum* of Formosa, and *P. versipelle* of south-eastern China. ——It is with great pleasure that we read the announcement of

the editor that the *Journal of Botany* will be continued, the support during the past year having been sufficient to leave a balance on the right side of the account.——In the October number of the *Torrey Bulletin*, Dr. Allen publishes some very interesting notes on the American species of Fortpella, with six plates of figures. A key to all the known species (12) is given, and four new species and a new variety are described. Eight species are found in North America, and these are widely enough distributed to warrant a search for them in any part of the country with a reasonable hope of success.——In the same number D. H. Campbell figures and describes some very simple prothallia of a fern (*Onoclea struthiopteris*). A row of four or five cells terminate in an apparently single celled antheridium! They were obtained by artificial culture under glass.——Robert Ridgway, in the December *Botanical Gazette* records a number of true measurements, which confirm the belief we have held for many years that the heights of our trees as given in the books and manuals are uniformly too low; witness the following: *Quercus michauxii*, 119 feet; *Carya porcina*, 115 feet; *C. microcarpa*, 134 feet; *Catalpa speciosa*, 101½ feet; *Fraxinus americana*, 127 feet; *Sassafras officinale*, 82 feet.——After a long delay, no doubt very vexatious to the author, the botanical portion of the thirty-third and thirty-fourth Annual Reports of the New York State Museum of Natural History have appeared. The first was transmitted to the legislature in February, 1880, and the last in March, 1881. Surely the State of New York ought not to delay so inexcusably the publication of such important reports. Both contain numerous descriptions of new species, and in each are good plates giving details of structure.

ENTOMOLOGY.[1]

Flight of Insects.—Dr. Amans in his extended paper describes his examination of the structure of the thorax in Æschna, Sirex and Locusta, and discusses the views of previous authors on the subject of flight of insects. He considers that a rational theory of flight can only be formulated after various dissections and numerous experiments on the resistance of the air; the laws of the latter are as yet very incompletely known, and as to anatomy, a knowledge of one animal hardly affords a sufficient basis for a general theory. For the investigation of preliminary problems Æschna is specially well adapted, as it is probably the most swiftly flying of insects, making, as it does, twenty-eight vibrations a second.

Antennary Rods of Vanessa 10.—J. Chatin describes the cavities found on the joints which form the tip of the antennæ of

[1] This department is edited by Prof. C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

this insect as communicating with the exterior by means of a very narrow orifice, which does not open directly to the exterior, but is more or less completely closed by cuticular ridges which approximate to and curve towards one another. Some authors, indeed, report the presence of an obturator membrane, but this is an appearance only, and seems to be due to the disposition of these parts; the rod or rods found in the pit have a peripheral zone, within which is a quantity of finely granular protoplasm; it is only in the young that one can observe the nucleus, as the rapid formation of pigment obscures the relations of this body; the bodies that have been described as nucleoli are due the granulation of the protoplasm, and the subsequent condensation of the pigment into small ovoid masses. The rod may be considered as a modified hypodermic cell of special function, and particularly characterized by the prolongations at either end; the lower of these is indicated by the nerve-branches; the upper appears to undergo a special differentiation, the exact investigation of which the author postpones for the present.—*Journal of the Royal Microscopical Society, December, 1883.*

Rudimentary Wings in Beetles.—Dr. H. Dewitz points out that the hind wings of the Coleoptera show most distinctly how an organ may gradually become aborted by disuse, and how a transformation of the whole habit of the animal may be connected with this. The membranous hind-wings of beetles, which serve for flight, lie, as is well known, concealed beneath the firm horny fore-wings, the so-called elytra. For the purpose of flight the elytra are raised, and the folded hind-wings extended, so as often to exceed the former in length. But many beetles do not fly at all. In these we find the hind-wings more or less aborted or entirely deficient. This phenomenon occurs with especial frequency among the Carabidæ, Melasomata and Curculionidæ, and also, although less frequently, among the Ptinidæ.

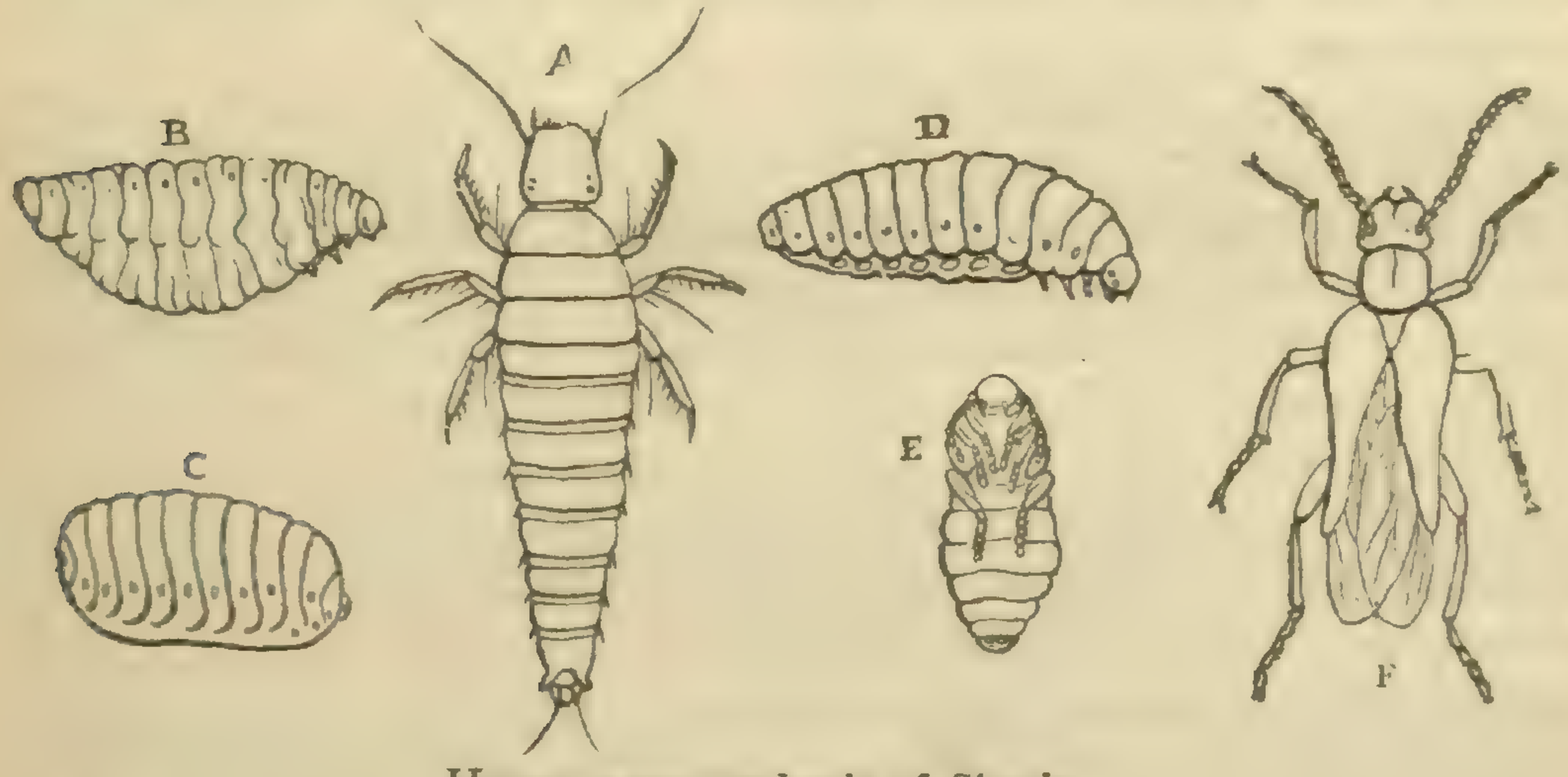
As the wings are already indicated in the larva, Dr. Dewitz was inclined to think that, in one or other of the species entirely destitute of wings, traces of these organs would occur, at least in the larval or the pupal stage. For four years his labors were in vain, and it is only quite recently that he succeeded in demonstrating the rudimentary hind-wings in the larvæ and pupæ of *Nipius hololeucus* Lam., in which both sexes are apterous, *i. e.* destitute of hind-wings. The fore-wing occurs in the half-grown larva, but the rudiment of the hind wing only shows itself much later when the animal is already on the point of terminating the larval stage.

We have in these rudiments of hind-wings an organ which is either advancing or has retrograded. That it is not an advancing organ, but one in course of disappearance, is shown most decidedly by the circumstance that this, like all retrogressive organs, does not, like those in full function, increase with the development of the individual, but, on the contrary, diminishes. We are there-

fore justified in assuming that *Niptus hololeucus* once bore well-developed hind wings, and that these gradually became aborted in consequence of disuse, until they were finally thrown back into the young stages, and some day will disappear even from these stages. In other wingless beetles this period may have already occurred.

This abortion of an organ brings after it other transformations of the body. Without the hind-wings the beetles cannot fly. It is therefore not necessary for them to be able to spread out the elytra, the latter remain permanently lying upon the back. What is the consequence? The two elytra grow together to form a firm dorsal shield, such as we find in nearly all beetles which are entirely destitute of hind-wings. At the same time the elytra become convex, and bend round at the sides, so that they embrace the abdomen. In consequence of the disappearance of the wing-muscles, the thorax becomes altered. The body acquires quite a different form; new forms are produced which we call species.

SITARIS AND ITS TRANSFORMATIONS.—Those who have read of the hypermetamorphosis of Meloë, and of Epicauta, &c., in preceding volumes of this journal, may be interested to note those of the European Meloë beetle, Sitaris, whose history was worked



Hyper-metamorphosis of Sitaris.

out by Fabre, in 1857. In the figure, *A* represents the first larva. It is hatched in the nest of bees, and when the male bees leave their holes in the spring, which they do before the females, the larvæ spring upon them, and afterwards crawl upon the females. The Sitaris larvæ devour the eggs laid by the bee, and then begin their hypermetamorphosis. The eyes disappear, and the legs and feelers become rudimentary (*B*), whilst they feed on the honey; the body and legs become short and thick, and finally a legless quiescent third stage *C;* then an active fourth one (*D*), which becomes a normal pupa *E*, the beetle being represented at *F;* all the figures being enlarged.

VARIATION IN THE ARCTIAS.—Rev. Dr. Hulst, in the Bulletin of the Brooklyn Entomological Society for October, relates how

from a single hatch of eggs of *Arctia excelsa* Neum. he reared twelve imagines in which the variation was so great as to create havoc among the species of Arctia. From his breeding Dr. Hulst now places *A. phalerata*, *pallida*, *celia*, *snowi*, *phyllira*, *figurata*, *placentia*, *decorata*, *flammea* and *excelsa* as synomyms of *A. nais* Drury, and *A. saundersii* Grote as synonymous with *A. parthenice* Kirby; *A. anna* Grote being merely a variety of the same species. Mr. Hulst is not singular in this respect. Our own rearing experience is similar and we anticipate some pretty extensive coalitions in Mr. Stretch's forthcoming monograph.

Affinities of Palæocampa.—In discussing the genealogy of the Myriopoda in a paper just issued from the Proceedings of the American Philosophical Society (Vol. xxi, p. 208) Dr. Packard concludes that Palæocampa—a caterpillar-like form described by Meek and Worthen, from the carboniferous of Illinois—is not a Myriopod as Scudder maintained, but that it may be regarded as the hairy larva of some carboniferous neuropterous insect allied to the Panorpidæ. He would therefore exclude it from any genealogical considerations in reference to the Myriopods.

The Hessian Fly.[1]—During the present summer I noticed that the Hessian fly was exceedingly destructive in some part of Perry county, Penna., especially near the west bank of the Susquehanna river, whole fields there were so badly injured that the crop was not worth reaping. It is the steady belief of the farmers in the county that the attacks of this insect are not, as is frequently supposed, most severe on the early sown wheat, on the contrary, they maintain that the earliest sown wheat, namely that put in during the first week of September, often yields a good crop, while that which is sown between the 10th and 22d is badly infested and the latest, that soon in the last week of the month, again escapes. The last part is of course natural and usual. But that the earliest wheat should thus yield well is not, I think, in accordance with the customary statements on the subject.

I am inclined to think that it may be accounted for in the following way. The early sown wheat may not escape the fly but may yield, as said above, a fair crop, because it grows strong and rank, and is thus better able to support an attack. A single "flax seed" will not materially injure a showy and healthy straw. But when, as I have seen them this season, five, six and seven are found together, the stem is so weakened that it must fall. The early sown wheat, especially if thick as it usually is in Perry county, sprouts or tillers out much more than the late wheat, and may consequently thus also make up for the destruction of some of its stalks by the fly.

It is not likely that the earliest wheat is avoided by the fly, and consequently the above explanation seems rational. It is the

[1] Abstract of a paper read before the Amer. Assoc. Adv. of Science, at Minneapolis

spring attack that does the whole mischief to the farmer who knows nothing concerning the autumn brood.

I have, moreover, been led to believe that an enormous destruction of the "flax seed" occurs during the winter, especially in the roots, which are entirely killed by the fly. I have often dug up and examined such roots during the winter and have many times found the pupæ nearly all dead and rotten. If further examination should confirm this observation we have an efficient cause checking to a great extent the excessive multiplication of this pest.

ZOÖLOGY.

NOTES ON AMERICAN MEDUSÆ.—No group of marine animals presents a more fascinating field for the discovery of unknown facts than the Medusæ. As in the progress of science isolated observations may come to have a value greatly beyond their apparent significance, I have thought it best to publish a series of disconnected notes on these animals. Many of them have been in MS. for some time, and I have preserved them in this form with the belief that new opportunities might give me such additional observations as would enhance their value. Many notes, and some of the most important, have already become antiquated through the studies of others. The remainder are presented below as a contribution to the study of the surface fauna of the ocean, to which naturalists are at present turning their attention with renewed activity.

Dinematella cavosa Fewkes.—The youngest larva of this genus known to me is represented for the first time in the accompanying cut (Fig. 1). The most important difference between it and the adult is the very small size of the apical projection of the bell. This portion of the nectocalyx barely rises above the surface in the larva, whereas in the adult it often projects to a height equal to the diameter of the bell itself. In this projection, however, even in this young condition, the curious cavity or brood sac (*c*) can be

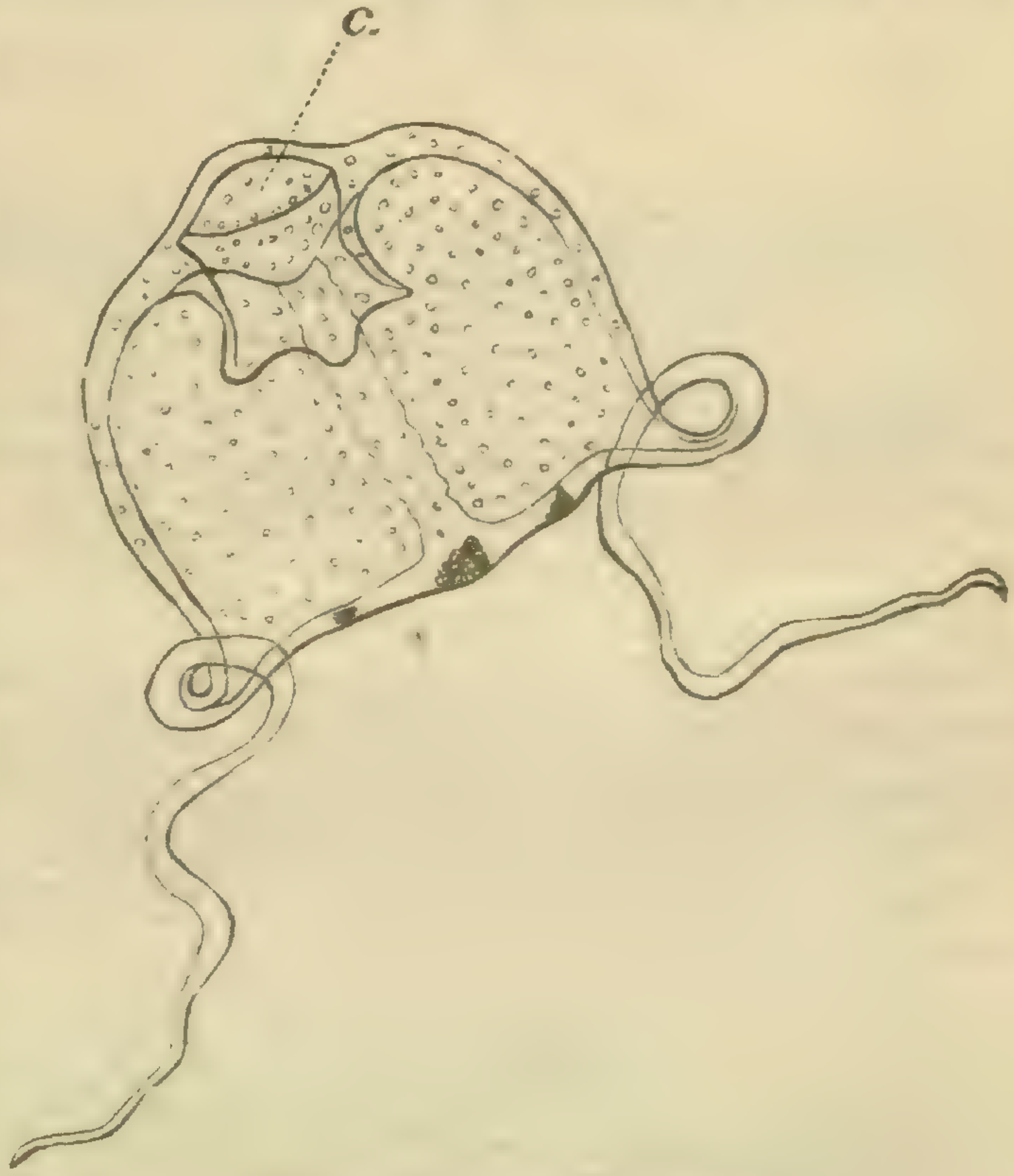


FIG. 1.—*Dinematella cavosa.*

easily seen through the bell walls. The remaining parts of the Medusa are the same as those of a larva a little older which is figured in the Bulletin of the Museum of Comparative Zoölogy, Vol. VIII, No. 8. Observations are needed to show what the function of the cavity (*c*) is in the adult.

Gemmaria gemmosa McCrady.—In the youngest larva of *Gemmaria gemmosa*, which has formerly been described, two well-developed tentacles arising from opposite ends of a diameter connecting the bell margin are represented.[1] In July, last summer, I took at Newport, R. I., a still younger Gemmaria than these, which has only one tentacle and the rudiment simply of a second diametrically opposite it, as shown in the figure.

FIG. 2.—*G. gemmosa* with one tentacle.

It will thus be seen that this stage of Gemmaria, as far as the unpaired tentacle goes, resembles Hybocodon and other unitentaculated genera. It is, however, possible that this specimen was an imperfect one, and that the other tentacle had been destroyed, or possibly that its growth had been abnormally retarded.

Oceania languida A. Ag.—Every student of the group of Medusæ is familiar with the fact that abnormalities are of frequent occurrence. Numerous instances might be cited, but a few examples will suffice. We find variations in the number of tentacles, otocysts, stomachs and other structures. Among the Discophora, in Cassiopea, as elsewhere[2] described, an abnormal specimen has a double ocellus on a single otocyst, and a doubled otocyst on a single peduncle. Among the free gonophores of Hydroids variations in the course of radial tubes are very numerous, but generally consist in multiplication of parts or the addition of one or more to the typical number. It seldom happens that the number of tubes is less than the normal number four, which is a constant characteristic of many if not all the true Oceanidæ.

The accompanying figure represents an *O. languida* from Newport with a perfectly formed bell but only three radial tubes, two of which (1, 2) have normal ovaries (*o*) and one (3) ends blindly in the bell walls, half way between the center of the Medusa

[1] A. Agassiz, North American Acalephæ, p. 184. McCrady, Gymophthalmata of Charleston Harbor, pp. 48–50.

[2] Bull. Mus. Comp. Zoöl., Vol. VII, No. 7.

and the bell margin. The Oceania seemed not in the least incommoded by the loss of the fourth and the reduction in size of a third radial tube, but moved with the same ease as if both were present and well developed. There is this inexplicable relationship in the position of the two perfect tubes which remain. In normal specimens of Oceania the angle 1 P 2 between adjacent radial tubes is a right angle; here, however, it is at least 120°. The same is true of the angles 2 P 3 and 1 P 3. From which side of the base of the proboscis, in relation to those already present, ought we to suppose the missing tube, if it had existed, to arise? Shall it be in the angle 1 P 2 opposite the aborted tube 3, or in the remaining angles 1 P 3, and 2 P 3? To throw light on this question let us turn to the appendages of the bell margin, where we would naturally expect concomitant variations. Between *a* and *b* on the bell margin, corresponding to the angle *a* P *b*, there are seven otocysts and four well developed tentacles. Between sections *a* and *b* of the margin, passing through *c*, there are fourteen fully-formed otocysts and eight tentacles, or just twice as many as on the first mentioned portion of the rim. The bell margin shares with the remainder of the umbrella the trifid character indicated by the radial tubes. It seems to be, therefore, that the bell margin confirms a theory, which the radial tubes suggest, that only three sectors exist in the umbrella, while the fourth is unrepresented on the bell margin as in the body of the umbrella.

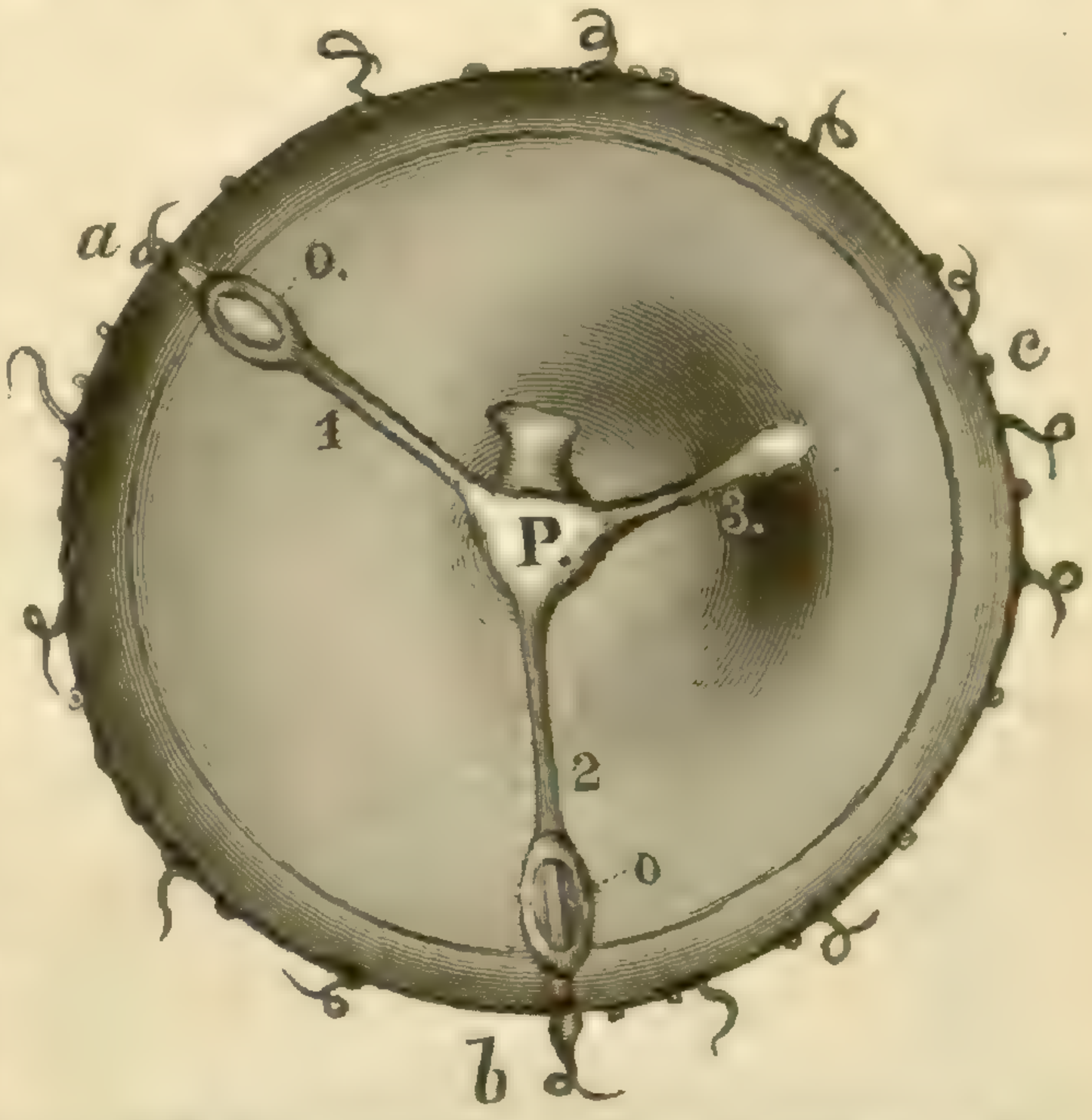


FIG. 3.—*Oceania languida*, aboral view.

Mnestra parasita.—Among the hydroid Medusæ we find very few examples of parasitic gonophores. One of the most interesting of these is the genus Mnestra, found parasitic on the abnormal mollusk, Phyllirhoë. The affinities of this Medusa have never been satisfactorily made out, and nothing is yet known of its development.

The existence of lateral appendages to the tentacles and the absence of otocysts, leads me to place it somewhere near Zanclea and Gemmaria. The tentacles (Fig, 4 *t*) are very stunted (Fig. 6), and from their tips there arises a cluster of lateral appen-

dages, each consisting of a number of thread cells enclosed in a capsule and mounted on a small peduncle.

There are four radial tubes, and the ovaries are found along the course of these tubes instead of near the proboscis as might be expected in a gonophore destitute of marginal otocysts. Certain organs which are identified as ovaries and lie on radial tubes, are pigmented a black color.

Each of the four radial tubes has, midway on its course, a slight enlargement forming a pocket into which it is not impossible that the young are dropped, and may be carried while the larva is passing through its younger stages. There is a very small proboscis, by which the Medusa is in part fastened to the body of its host (Fig. 4).

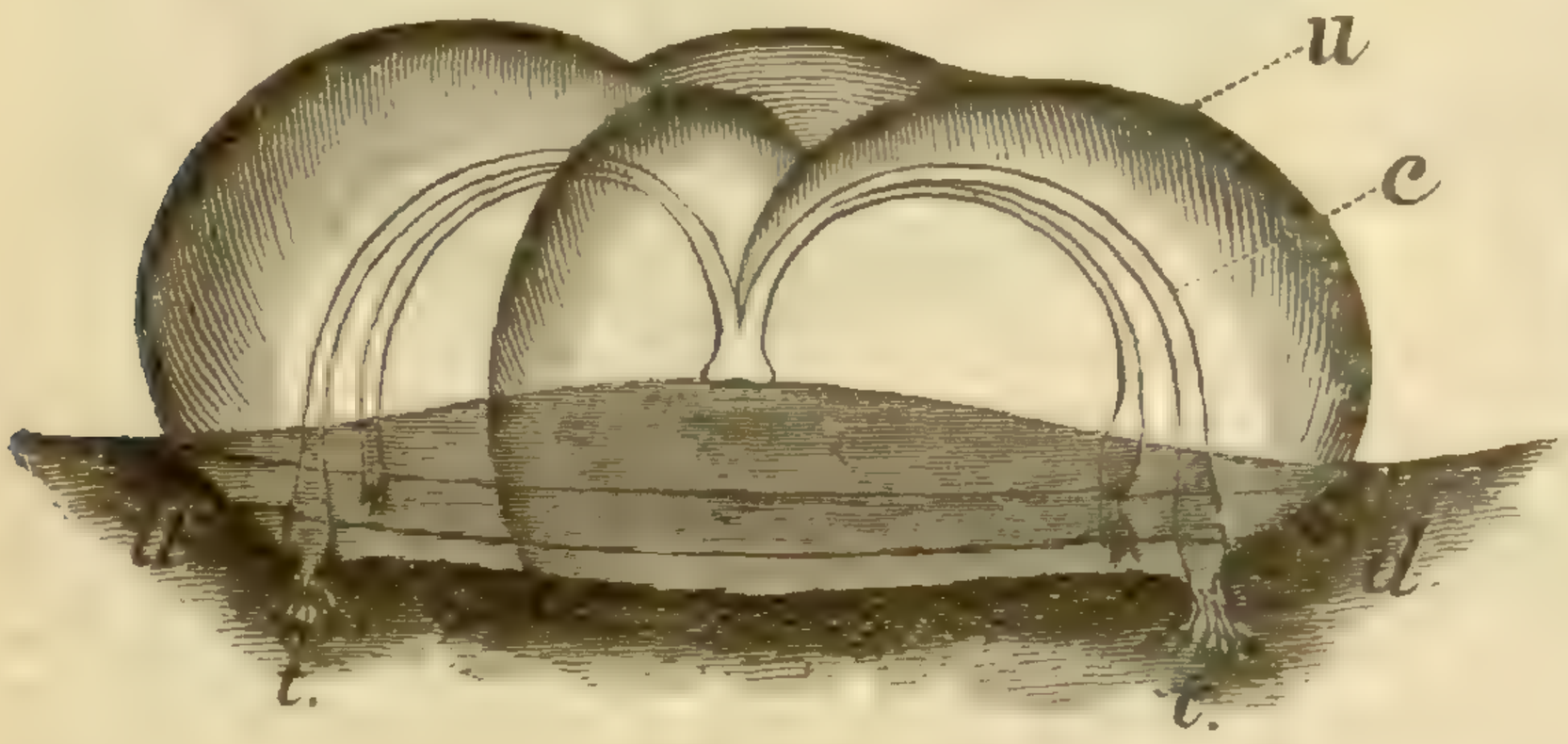


Fig. 4.

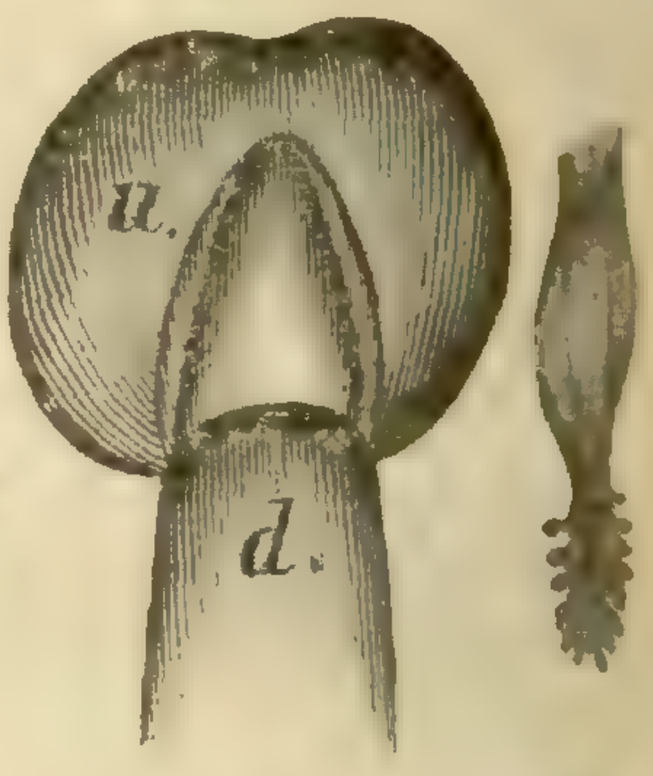


Fig. 5.

Fig. 6.

FIG. 4.—*Mnestra parasita* attached to the edge of the body of Phyllirhoë; *c*, radial tubes; *d*, body of Phyllirhoë; *u*, umbrella. FIG. 5.—Section of Phyllirhoë and Mnestra body, showing how the umbrella of the latter embraces the throat of the former. FIG. 6.—Tentacle of Mnestra with side branches.

The specimens from which these observations were made are alcoholic and differ somewhat from the Mediterranean species in size and form. They have, however, the same parasitic life upon Phyllirhoë, and the variations mentioned are probably due to influence of the alcohol in which they are preserved.

Locality, Florida reefs.

Abyla pentagona Forskal.—One of the few genera of Siphonophora which has not yet been recorded from American waters is the well-known *Abyla pentagona* of the Mediterranean. A single specimen, undoubtedly of this genus and probably of the same species as the above, was found in a bottle of gelatinous animals of all kinds collected by a friend on the western coast of Florida, near Tampa bay.

Gleba hippopus Forskal.—The U. S. Fish Commission, as I have elsewhere[1] mentioned, found a single specimen of this Siphonophore off Nantucket, and a second was collected by the *Blake* in the Gulf Stream in 1880. I have to record a third specimen taken from the Gulf of Mexico, near Tampa bay, the first time, as far as I know, that the genus has been mentioned from this locality or the Gulf of Mexico.—*J. Walter Fewkes.*

[1] Bull. Mus. Comp. Zoöl., Vol. IX, No. 7, p. 275, Note. No. 8, figs. 31, 32, 33.

Life in the Naples Aquaria.—H. Eisig placed in a basin of water an Octopus, a Gobius and a Pagurus, with an Actinian on its shell; the Octopus attacked the crab, which immediately withdrew into its shell, while the attacker instantly retreated, for the stinging organs of the Actinia had been too much for it. The same thing happened with the goby. A Pagurus without a shell was afterwards placed near the Octopus, and the latter examined it very carefully before it dared to seize it. At the same time it is to be observed that the Actinian gets much assistance from its commensal, thanks to the locomotive and olfactory powers of the latter.

Observations on thermal conditions showed that many fishes and other marine forms were but little affected by alterations in temperature; while a study of the modes of nesting of marine forms shows that much depends on what region of the sea the subjects naturally inhabit, and considerable differences are to be observed between pelagic and more deeply dwelling fishes and cephalopods.—*Journ. Roy. Microscopical Society, Aug., 1883.*

New Human Cestode—Ligula mansoni.—Dr. S. S. Cobbold describes a Cestode, twelve of which were found in a Chinese, lying in the subperitoneal fascia, about the iliac fossæ, and behind the kidneys, a single one being found lying free in the right pleural cavity. They were from 12 in. to 14 in. long, 1-8th in. broad and 1-64th in. thick. The Cestode comes nearer to *Ligula simplicissima*, frequently found in the abdominal cavity of fresh-water fishes, than to any other species, and without asserting positively that it may not be a variety of that form, the author thinks, from the unique character of its habitat, associated with certain differences of form, that it may properly be regarded as the immature representative of a totally distinct species.—*Journ. R. Micr. Soc.*

Hydro-medusa without Digestive Organs.—Dr. Lendenfeld describes a new sub-family of hydroids, Eucopellinæ, in which the medusa has no digestive organs, and lives only a short time after its escape from the gonophore. Only one species, *Eucopella campanularia*, is known, and this is found in Australia. The larva is a campanularian whose hydranths are carried upon almost unbranched stems, which spring from a creeping root. The medusa has a veil, well-developed marginal sense-organs, radial and circular chymiferous tubes, and large reproductive organs, but it has no mouth, stomach, or tentacles. It discharges its reproductive elements within twenty-four hours after its liberation, and it lives only about thirty-six hours.—*Journ. Roy. Microscopical Society, Aug., 1883.*

Blue Coloring Matter of Rhizostoma.—R. Blanchard has a note on his own investigations into the blue coloring matter of *Rhizostoma cuvieri*, in which he points out the differences between his results and those lately obtained by Kleinenberg on the same

body; one which the latter author distinguishes as cyanein. The French observer finds that the tissues give up the color after death, and that the blue color of the aqueous solution disappears when heat of from 40° to 45° is applied, and gives place to a well-marked rosy hue, which again disappears on cooling. Spectroscopic examination reveals the presence of three absorption-bands, one in the red, one in the yellow, and one in the green region; the second of these corresponds almost exactly in position to the sodium-band. If the aqueous solution is treated with ammonia the blue color is immediately precipitated under the form of small blue flakes which may be collected on the filter-paper and analyzed. The author hopes that further investigations will reveal the cause of the differences which obtain between his results and those of Kleinenberg.—*Journ. Roy. Microscopical Society, Aug., 1883.*

An Oyster on a Crab.—A fisherman has sent me a small crab with an oyster somewhat larger than itself ensconsed on the right side of its carapace. The crab is *Cancer irroratus* Say, and is a young female which has but just attained puberty. The shield is two inches across, and one-and-three-fourths inches from front to back. The caudal flap is distended with eggs. The oyster is two-and-half inches in length, and two inches wide, and is firmly attached to the right extremity of the carapace. It is a wonder how the prospective little mother could manage her charge so far, and at the same time carry such a lobsided encumbrance; the crab is hardly more than one-fourth fully grown. The oyster, it is pretty certain, is about four months old.—*S. Lockwood.*

Moulting of Limulus.—I was much interested in Mr. B. F. Koon's article in the December Naturalist, on Sexual Characters of Limulus. But it caused surprise to see a discussion of points which I thought were settled in my article on the Horse-Foot Crab, in Am. Naturalist, Vol. iv, 1871, p. 257. The points there made are that the male Limulus does not assume the large claws or claspers until puberty, which I expressed the belief did not come until the age of three or four years. Hence the exuviæ of the young crabs show no difference of the forward claws. I also observed the probable numerical equality of the sexes. As to the exuviation of large crabs, I gave instances and measurement of increase. Where these crabs are common the shedding of the adult is not a rare sight.

As to finding undoubted exuviæ of the adult males brought up by the sea, it is uncommon to find such of either sex. The young have very light shells, and their exuviæ are easily brought shoreward by the wash, and often make vast wind-rows. Whereas the adult exuviæ are heavy, and are seldom found brought up. I think, too, that the young crabs prefer shoaler waters than

do the adults. I have shown that at considerable depths, even in winter, the large adult has been known to shed. Had Mr. Koon consulted the article referred to he could not have written, "We are led to believe that large Limuli rarely, possibly never, shed, because among all those examined, there were no large exuviæ." On seeing the act of exuviation by a large Limulus, an officer of the United States Army, at the fort at Sandy Hook, N. J., exclaimed: "The animal is spewing itself out at its mouth!"—*S. Lockwood.*

SOGRAFF'S EMBRYOLOGY OF THE CHILOPOD MYRIOPODS.—We have received from the author an elaborate memoir, unfortunately in the Russian language, and with no complete abstract in French or German, on the embryology of two species of Geophilus (*G. ferrugineus* and *proximus*). It is a large quarto brochure of 77 pages, dated Moscow, 1883, with the illustrations, printed sometimes in three colors, inserted in the text; as the drawings of the sections and complete embryo are on a large scale, one can form some idea of the nature and high value of the author's work. The bibliographical references are full and satisfactory. Beginning with careful comparative descriptions of the two species of Geophilus, whose development is described, the internal reproductive organs are figured and elaborately described. In a partial abstract which appeared in the *Zoologischer Anzeiger* for Nov. 6, 1882, Sograff states that the best material for his researches were the above-named species of Geophilus. The Lithobii present much more difficult material for study, as their eggs are scattered in the earth or in the humus of decaying vegetation, and are like small particles of sand, from which they often can with difficulty be distinguished; besides this the egg-membranes are unusually thick, rendering them difficult to study. The eggs of the Geophili lie under the bark of trees (*G. proximus*) or in sandy soil (*G. ferrugineus*) in small bunches, eighteen to thirty-five in number, and are protected and watched by the female. It is very difficult to keep the eggs alive in confinement, since they are attacked by fungi. It is also almost impossible to study the eggs in all stages of one and the same brood, so that one has to make almost daily excursions for material for study.

The eggs of *Geophilus ferrugineus* are ruby-red and almost perfectly transparent, they are probably those figured by Metschnikoff in his researches. While in the oviduct the egg is enveloped in a transparent coat, which appears to consist of the united chorion and yolk membrane, for these structures can be distinguished in young ovarian eggs. At this stage the egg is filled with yolk, hiding the germinal vesicles and yolk nucleus; but on one occasion a nucleated mass of protoplasm—the nucleus being spindle-shaped, and exhibiting division of its chromatin into two groups of rods—was found in the center, probably derived from the germinal vesicle. The nucleus and protoplasm divide into a

considerable number of portions; the central cleavage-masses are round or polygonal, the peripheral ones stellate. Yolk cleavage now takes place, the yolk breaking up into pyramidal masses, as in the Decapoda, these masses carrying portions of protoplasm upon their apices; the segmentation is not dichotomous; the number of pyramids was always the same, and the only difference between the young and the perfect pyramid consists in an indefiniteness of outline in the apex of the former. The simultaneous origin of the masses is not an impossible circumstance, and is explained by the action of the central protoplasm in drawing into itself the superincumbent yelk. The protoplasm-masses of the yelk now sink into the pyramids which form the primary endoderm, and the central protoplasm-masses come to the surface of the ovum and form the primary ectoderm. In the Chilognatha, judging from Polydesmus, the method of formation of the blastoderm more resembles that of the Crustacean and Arachnida; the yelk cleavage appears to have been correctly described by Metschnikoff. The blastoderm of Geophilus consists at first of large, pale, very thin cells, dividing very rapidly so as to form, in the course of twenty-four hours, a number of very small cells, which are, however, smaller on one side of the ovum than on the other; on this side the primitive streak appears, beginning at its anterior end, which develops the first segments and appendages before the hinder portion is clearly defined. Before the appearance of the primitive streak the mesoderm is divided off from the small-celled ectoderm, and at the same time nuclei, invested by means of protoplasm, emerge from the yelk-pyramids and apply themselves to the mesoderm; these masses seem to be derived from the nucleus of the ovum, and to have hitherto remained at the center. The mesoderm, like the primitive streak, develops first in front. The conversion of the yolk-pyramids into endoderm, *i. e.*, into the epithelium of the mid-gut, only takes place when the embryo is fully formed; it commences during that stage which Professor Metschnikoff did not observe, and at the same time as the beginning of flexion of the embryo.

The two preceding paragraphs have been taken from the translation in the Journal of the Royal Microscopical Society of the author's abstract (published in the *Zool. Anzieger*, v. 582). The later stages are described in detail, with sections, both transverse and longitudinal, and views of the complete embryo at different stages; with some sketches of the later embryo of Lithobius. The structure of the nervous system is described and figured, including the brain of Scolopendra, in a comparative way. A translation of the entire memoir would be most desirable.

New Cave Arachnids.—The following cave Chernetidæ, Phalangidæ and Nemastomatidæ are interesting additions to our cave-fauna.

Obisium caricola, n. sp.—This is an aberrant species, but ap-

parently belongs to this genus. The cephalothorax is much longer than broad, widest just before the middle, narrowing in front and behind, and deeply cleft between the cheliceræ, an unusual feature in the genus. There are no eyes. The cheliceræ are rather smaller than usual and separate at base; the head is shorter and the fingers longer than usual. The pedipalps are as long as the body without the cheliceræ, and are rather thick. The abdomen is narrow and rather long, with the segments well marked. Length of body including the cheliceræ $2^{mm.}$ One specimen, collected by us in the Newmarket cave, Va.

FIG. 1.—New Cave Obisium.

Chthonius cæcus, n. sp.—Body unusually short and broad, and the limbs short and thick. Eyeless. Cheliceræ very stout and thick. Pedipalps unusually short; the 2d joint short and twice as thick as in *C. packardii* Hagen; 3d joint short, thick, conical; manus very short and thick, really but little longer than the 3d joint; the movable finger nearly twice as long as the manus; it is stout and very straight, and serrulate on the inner edge. Legs short and thick. Length of body with the cheliceræ, $1.5^{mm.}$ Two specimens collected by us at Weyer's cave, Va.

Phlegmacera cavicolens, gen. et sp. nov.—*Gen. chars.*—In this genus of Phalangidæ the body is not spiny, is slightly compressed, much less flattened than usual, no broader than high, and the tergal as well as ventral surface is unusually convex and rounded. The cephalic plate bearing the eyes is about half as long as broad. The abdomen forms two-thirds the length of the body, with nine segments seen from above. Cheliceræ 3-jointed. Pedipalps 6-jointed, considerably longer than the body. It has no very close affinities to any of the European genera.

Sp. Chars.—Eyes large, prominent, scarcely situated on an eminence, black and well developed. A series of large, short but broad dorsal, transverse, blackish spots, and broad dusky lateral diffuse band. Cheliceræ with manus rather thick, the fingers very unequal; the movable fingers about two-thirds as long as the manus with a series of about 24 separate stiff, straight, setæ. Pedipalps densely setose, from $\frac{1}{4}$–$\frac{1}{3}$ longer than body, 5th joint longer than any of the other joints, and much swollen, oval; 6th no longer than 5th is wide. Fourth pair of legs with joint 5 divided at the end into nine minute joints, and the last tarsal joint (joint 6) subdivided into twelve joints. Length of body, $4^{mm.}$; thickness, $2.5^{mm.}$; width, $2^{mm.}$ Bat cave, Carter Co., Ky. Two specimens.

Nemastoma inops, n. sp.—Eyes wanting, with traces of a retina,

however. Chelicerae slender, rather long, inner edge of each finger with short, stiff setæ. Pedipalps of moderate length; 2d joint not much longer than the basal, being slightly longer than thick; 3d joint three times as long as the 2d; 3d and 4th of the same length, but the 4th a little thicker; 5th slightly longer and thicker than the 4th, with numerous stout setæ of nearly even length; 6th (terminal) two-thirds as long as the 5th and nearly as long in proportion as the terminal joint in *N. troglodytes* Pack.; it is very setose, and the tip is rounded.

Legs of the 2d pair 3^{mm} in length, hairy, last tarsal joint undivided; 4th pair 4^{mm} in length; the last tarsal joint with nine subjoints, and the claws smaller than in the 2d pair.

Length of the body, including the chelicerae, 1^{mm}. Bat cave, Carter Co., Ky. Two immature specimens, but the species is very characteristic, and this is the first occurrence of the genus east of the Great Basin.

Ventral Repugnatorial Organ in Centipedes (Geophilus.—The gland which emits a red liquid by certain disks in the median ventral line of *G. gabriellis*, has been studied by M. Passerini. The disks are epidermal structures about 0.2^{mm} in diameter in adults, and are placed in slight depressions of the integument, one on each foot-bearing segment; their center is occupied by about a hundred glistening bodies, which are the truncate ends of a corresponding set of conical mouth-pieces belonging to long ducts, each of which leads from a long pyriform gland. This gland is called unicellular by Passerini; its basal membrane, which is very thin, contains a number of smooth and striated fibers which ramify, anastomose, and form a reticulum, and are connected similarly with those of the neighboring glands, and extend over the ducts. The larger fibers, some of which measure 0.012^{mm} in diameter, start from common centers. The fibers very often exhibit a succession of slight inflations, and are evidently contractile and intended to compress the gland and expel the contents. The system of glands belonging to one segment is invested by a delicate membrane containing weak fibers and surrounded by adipose cells, and it is innervated by nerve-branches derived from the anterior nerve of the pair which is given off on each side by the ganglion of the segment; the tracheæ belong to a branch which comes direct from the main trunk.

The liquid contained in the gland coagulates promptly in the air, has an acid reaction and taste, and irritates the tongue, is soluble in water and alcohol, and becomes whitish under the action of caustic potash; the coagulum shows, under the microscope, an amorphous mass containing elongated crystals, which generally form rosettes about 0.14^{mm} in maximum diameter; analysis shows its composition to be analogous to that of silk. The only direct

evidence as to the function which the author was able to obtain, was that when the back is mechanically irritated the animal turns up its ventral surface and the disks become covered with the fluid, the object of which seems to be retaliation.—*Journ. R. Micr. Soc.*

ALBRECHT ON THE MORPHOLOGICAL VALUE OF THE MANDIBULAR ARTICULATION.—In this pamphlet M. P. Albrecht combats the general idea that the ear-bones are homologous with different parts of the first, or first and second visceral arches—parts which are distinct bones in the lower gnathostomes. His argument is as follows: In all non-mammalian gnathostomes the articulation of the mandible is between the articular element and the quadrate, and good evidence is needed to the contrary before we are bound to believe it otherwise in mammals. He maintains that the squamosal is a compound bone, formed of the true squamosal and the quadrate, and that the mandibular articulation is with the latter element, just as in other gnathostomes. This belief is founded upon the state of things existing on the left side of a new-born infant's skull in the writer's possession. In this skull the temporal of the right side is normal, but on the left side the zygomatic part is isolated from the true squamosal, which is united with the ali-sphenoid. Cases of a sutural division of the squamosal into an upper and lower portion are cited. If then, the zygomatic part of the squamosal is really the quadrate, and the mandibular articulation is the same in all gnathostomes, another explanation of the ear bones must be sought for. After enumerating and tabulating the various conflicting theories of Reichert, Günther, Gegenbaur, Huxley, W. K. Parker, Salensky, Kölliker, Wiedersheim and Fraser, upon this point, M. Albrecht declares that for him the bones of the ear are nothing more or less than dismemberments of the columella of the Amphibia. In the Urodela this columella is a cartilaginous rod connecting the tympanum with the fenestra ovale; in the Anura it consists of four cartilaginous portions which perform the same office, and are without question homologous with the single cartilage of the urodela; and in the Mammalia the four tiny ear bones are identical in position and function, and homologous in origin with, the four cartilages of the anuran columella. The columella in all these cases is without question homologous with the suspensorium of the mandible of gnathostomes that have no columella. The extra-mandibular part of Meckel's cartilage, in M. Albrecht's opinion, belongs to the malleus, and is homologous with the suspensory-articular ligament of selachians, with the symplectic-articular ligament of teleosts, and with the columello-articular ligament of the Batrachia and Sauropsida. Thus the arrangements are the same throughout, and the suspensorium of the mandible exists in fishes, Batrachia, Sauropsida and Mammals.

Characters of Human Femora.—Dr. E. Houzé, in the bulletin of the Anthropological Society of Brussels, gives the result of an examination into the third trochanter as it occasionally appears in a rudimental condition in man. He finds it to be more common in the higher than the lower races, as it is the point of insertion of the gluteus maximus muscle, which is in man intimately connected with the maintenance of the erect position. Thus it is very rare in the Anthropoid apes which are "platypyges;" it is rare in the negroes which he terms "micropyges," while it is very common in Europeans, who are "megapyges," or have the gluteus muscles best developed. It is rather more common in women than in men. The hypotrochanteric fossa is situated below the third trochanter. It is rare in men of the present period, but is constantly present in the femora of the men of the reindeer epoch in Belgium. It is found in men from Grevelle and Cro-Magnon in France.

Zoological Notes.—*General.*—Professor E. H. Giglioli, in a written note appended to an inaugural discourse delivered by him at the opening of the new hall, for the Central Collection of Italian Vertebrates in the Museum at Florence, states that there are now in that collection more than 22,000 specimens, including examples of all the mammals (108 species), reptiles (41 species), and batrachia (21 species) found in Italy. The birds are represented by 22,000 examples and 415 species, and the fishes by more than 14,000 specimens and 554 species, yet these classes are not quite complete. The same naturalist writes of the recent discoveries by the Italian vessel *Washington* and the French *Travailleur* as the "discovery of an abyssal fauna in the Mediterranean," since Dr. Carpenter had confidently asserted the scarcity of life in the depths of that sea. Among the results obtained by the *Washington* were Willemœsia, Dorocidaris, Brisinga, Argyropelecus, Gonostoma, Hyalonema, *Chlorophthalmus agassizi*, a singular fish with large emerald eyes, Gadiculus, *Macrurus scelerorhynchus*, and many other interesting forms. Species which are known to inhabit depths eight times greater were found at depths of 400 to 500 meters.

Reptiles.—Dr. J. G. Fischer has recently described *Cnemidophorus affinis*, from Hayti; *Euprepes elegans* from Sierra Leone; *Sphenocalamus lineolatus*, a new genus and species of calamarid from Mazatlan, *Homolocranion lineatum* from Venezuela; *Lepidophis frenatus* from Sierra Leone; *Bothriechis trianguligerus* from Guatemala; and *Helicops marginatus*.

Fishes.—The report of Messrs. Goode and Bean upon the fishes dredged during the summer of 1880 on the east coast of the United States enumerates fifty-two species, of which five were Pleuronectidæ, including two new species; six Macruridæ with three new species, eight Gadidæ, with one new species, three Cotti-

dæ, with one new species, four Lycodidæ, two of which are new; and three Sternoptychidæ, one of which is new. Most other families are represented by one species only, but include a new species of Alepocephalus, Bathysaurus, Halosaurus, and Mettastoma, as well as *Poromitra capito*, a Berycoid fish. Altogether, the list of United States fishes receives seventeen additions.——W. K. Parker has published a memoir with twelve colored plates upon the structure and development of the skull in the sturgeons *A. ruthenus* and *A. sturio*. His conclusions are that we have in the sturgeon a form practically intermediate between the Selachians and the Holostei. The first stages of the cranium are, to use his own words, "confusingly simple," and he believes that the vertebral segmentation of the skull is *a comparatively late and secondary specialization*. The same anatomist also, in the Philosophical Transactions of the Royal Society, gives an exhaustive account, with nine plates of sections, etc., of the development of the skull in *Lepidosteus osseus*. In comparing the skull with those of Polypterus and Amia, he says "Amia is a true Ganoid, and has several unmistakable diagnostics even in its skull, but it comes very near to the Physostomous Teleosteans.——In the Proceedings of the United States National Museum, Messrs. Jordan and Gilbert give a review of the American Carangidæ, with the synonymy and geographical distribution of each species. The genera recognized in the family are only six: Megalaspis, Decapterus, Trachurus, Caranx, Silene, and Chloroscombrus. The artificiality of generic distinctions generally is to some extent acknowledged in the following words: "This division is not wholly natural, inasmuch as the differences between the extremes among the species of Caranx are greater than those separating some of these species from related genera, while, on the other hand, the characters separating Trachurus and Silene from Caranx are technical only." Decapterus has five American species; Trachurus is credited with two, the *Caranx symmetricus* of Ayres being accorded specific rank with the name of *picturatus;* Caranx, of which Blepharis, Vomer and seven others are made sub-genera, has nineteen species, Silene two, and Chloroscombrus two, making thirty species in all. In the same Proceedings, Dr. T. H. Bean records the first occurrence of *Pseudotriacis microdon* Capello on the shores of the United States. It is a rare species, and was before known from Portugal only. The example referred to came ashore at the Amagansett life-saving station on Long Island. Professor Jordan describes a new Muræna from the Galapagos islands. He separates under the name of Sidera those species of Muræna, which have the posterior nostrils without tubes, and the teeth all sharp, and gives to the new species the name of *S. ehlevastes*. Messrs. Jordan and Gilbert also described a new species of Rhinobatus *(R. glaucostigma)* from Mazatlan. In the same Proceedings Miss Rosa Smith describes the life colors of *Cremnobates integripinnis*, and notices

the occurrence of *Gasterosteus williamsoni* in an artesian well at San Bernardino, California.——Messrs. Evermann and Meek (Proceedings Academy Natural Sciences, Philadelphia, 1883), define sixteen species of Gerres, and review the species found in American waters. *G. homonymus* is considered identical with *G. gula* C. and V. and *G. harengulus* with *Eucinostomus pseudogula* of Poey and *Diapterus gracilis* of Gill.

Birds.—Dr. R.W.Shufeldt publishes in the Journal of Physiology and Anatomy (XVIII, 86), observations on the osteology of *Podasocys montanus*, illustrated by a plate. In 1859 the skins of but two of these birds were in the Smithsonian collections. Upon its native plains, and in the open parks of the Rocky mountains, it has all the habits and action of a true plover, lacking only in the noisy traits of Vanellas and Ægialites.——The Bulletin of the Nuttall Ornithological Club for October, 1883, contains a notice by Dr. C. H. Merriam, of the yellow-green vireo, which has not before occurred north of Fort Brown, Texas. It was found dead in the Province of Quebec, Canada, and was probably a storm waif. Dr. Merriam also states that the harlequin duck, a common summer resident in Newfoundland, nests in hollow trees. His authority is James P. Honley, of the Newfoundland Geological Survey, who writes: "It is quite true the birds nest in hollow stumps of trees, usually on islets in the lakes or tarns of the interior. They usually frequent the larger lakes and rivers far from the sea-coast, but are found scattered all over the country."——W. Brewster notices an apparently new gull from Northeastern America, which Kumlien regarded as *Larus glaucescens*, but which Brewster renames *Larus kumlieni*.——The nest and young of the pigmy owl at Fort Klamath, California, are described by C. F. Bendire.

Mammals.—Dr. J. B. Holder, of the American Museum of Natural History, New York, has added further to our knowledge of the right whale of the north temperate Atlantic (*Balæna cisarctica* Cope) by the publication of figures and descriptions of the exterior characters and osteology of three or four examples, including both sexes. The head is always relatively shorter than in *B. mysticetus*, but a female from the New Jersey coast has a longer head than the males. Dr. Manigault, in a letter to Dr. Holder respecting an example taken at Charleston, South Carolina, states that a fishery for this whale is carried on to a limited extent off the coast of South Carolina and Georgia, and that it attains a length of sixty feet.

PHYSIOLOGY.[1]

DIGESTION WITHOUT A STOMACH.—In the *Archiv f. Anatomie u. Physiologie*, 1883, M. Ogata describes some remarkable experiments upon the digestive powers of animals in which the influence

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

of the stomach was nearly or completely excluded. A dog was submitted to an operation in which the whole of the stomach was removed except a small part of the wall near the cardiac entrance of the organ. The free edges of the alimentary tube were sewed together, the animal completely recovered from the operation and was killed six years after for the purpose of post mortem observation. During that period the dog remained in perfect health, gained in weight and readily digested the most various food matters. The fœces were quite normal in character. Ogata studied the subject farther in various ways. In dogs possessing a gastric fistula food matters of different kinds were introduced, by means of a tube passed through the opening in the stomach wall, directly into the duodenum, the gastric juice being prevented from passing the pylorus by means of an appropriate plug. When mixed tissues, such as pieces of liver, lung or intestinal mucous membrane were thus introduced into the duodenum, it was found that the cellular or albumen-containing elements were most readily dissolved, while the collaginous and reticular tissues were comparatively unaffected. Elastic tissue was also dissolved, but more slowly than the first-named. With vegetable substances it was found that the cell contents were dissolved while the cell-walls, though apparently offering no great resistance to the diffusion of the intestinal juices through them, remained undigested. A number of dogs were fed in the way described with meat or eggs and killed in a painless manner at different times after giving the meal. It was found that the food in each case had provoked active secretion of the alkaline fluids of the pancreas and intestine and that a large amount of material was digested and absorbed within two hours after feeding. The conclusion arrived at is that albuminous bodies and cooked connective tissue are digested as thoroughly and speedily by juices poured into the intestine alone as by the secretions of the stomach and intestine together. In these digestions there seemed to be a very limited flow of bile. Comparative experiments showed that albuminous substances were digested much more completely and speedily in the intestine alone than in the stomach alone, and such food matters were digested more rapidly when brought directly into the intestine than when taken in the natural manner by the mouth.

Measurements of the Depth of Sleep.—Two of Vierordt's pupils have made the depth of sleep the subject of an investigation. They worked upon the principle that the depth of sleep is proportional to the strength of the sensory stimulus necessary to awaken the sleeper, that is, to call forth some decisive sign of awakened consciousness. As a sensory stimulus they made use of the auditory sensation produced by dropping a lead ball from a given height. The strength of the stimulus was reckoned, in accordance with some recent investigations of Vierordt, as increasing, not directly as the height, but as the 0.59 power of the

height. For a perfectly healthy man, the curve which they give shows that for the first hour the slumber is very light; after one hour and and fifteen minutes, the depth of sleep increases rapidly and reaches its maximum point at one hour and forty-five minutes the curve then falls quickly to about two hours and fifteen minutes and afterwards more gradually. At about four hours and thirty minutes, there is a second small rise which reaches its maximum at five hours and thirty minutes, after which the curve again gradually approaches the base line until the time of awakening.

Experiments made upon persons not perfectly healthy, or after having made some exertion, gave curves of a different form.—*Science.*

EXPERIMENTS UPON THE HEART OF THE DOG WITH REFERENCE TO THE MAXIMUM VOLUME OF BLOOD SENT OUT BY THE LEFT VENTRICLE IN A SINGLE BEAT, AND THE INFLUENCE OF VARIATIONS IN VENOUS PRESSURE, ARTERIAL PRESSURE, AND PULSE-RATE UPON THE WORK DONE BY THE HEART. By W. H. Howell and F. Donaldson, Jr.[1]—Owing to the indirectness of the methods hitherto used for estimating the quantity of blood pumped out from the left ventricle at each systole, this important factor in all calculations of the work done by the heart has never been satisfactorily determined. Volkmann, and afterwards Vierordt, from calculations based upon the mean velocity of the stream of blood in the unbranched aorta, obtained the fraction $\frac{1}{400}$ as representing the ratio between the weight of blood thrown out at each systole and the body-weight. Fick, from data obtained by placing the arm in a plethymograph, arrived at a much smaller fraction, viz. In our investigation we have made use of the dog's heart, completely isolated from all other organs of the body, with the exception of the lungs, after the method devised by Professor Martin. By this method it is possible to estimate directly the quantity of blood ejected from the left ventricle at each systole.

With regard to the maximum quantity of blood which can be thrown out from the left ventricle at a single systole, the general result of the experiments may be stated as follows: With a mean pulse-rate of 180 per minute, the mean rate of the maximum weight of blood pumped out from the left ventricle at each systole to the body weight is $\frac{1}{855}$ or .0017. In one experiment in which the pulse-rate was 126 per minute, about the normal rate, the ratio obtained was $\frac{1}{700}$ or .0014. In applying these results to the normal dog, we believe that the average quantity of blood pumped out from the left ventricle at each systole in the living dog, is approximated most closely in the experiments given by the maximum outflow obtained from the isolated heart.

Variations of arterial pressure, from 58 to 147 millims. of mer-

[1] Abstract reprinted from the Proceedings of the Royal Society of London, No. 2[illegible] 1883.

cury, were found to have no direct effect whatever upon the quantity of blood sent out from the left ventricle at each systole. Since the pulse rate is not altered, the work done by the left ventricle varies directly as the arterial pressure against which it works, within the limits named. For how much wider limits than those given this may hold true was not determined. There is every reason to believe that under normal conditions the force of the systole is more than sufficient to completely empty the ventricular cavity, and since, with arterial pressures from 58 to 147 millims., the quantity of blood ejected at each systole remains constant, it seems probable that within these limits, at least, the force of the ventricular contraction is not influenced by variations in arterial pressure, but remains maximal throughout.

Variations of venous pressure on the right side of the heart influence in a marked manner the outflow from the left ventricle. As the general result of the experiments it was found that the outflow from the left ventricle, and consequently the work done by it, increases with the venous pressure, but not proportionally, up to the point of maximum work.

Variations in the rate of beat of the heart were obtained by heating or cooling the blood supplied to it. The general result may be stated as follows: A diminution of pulse-rate, brought about by lowering the temperature of the blood flowing into the heart, causes an increase in the quantity of blood thrown out from the ventricle at each systole, and consequently an increase in the work done at each systole, and *vice versa*. The changes in the outflow from the ventricle at each systole are not, however, inversely proportional to the changes in the pulse-rate. The total outflow, and, therefore, the total work done during any given period of time, decreases with a diminished pulse-rate, and increases with an increased pulse-rate.—*Johns Hopkins Univ. Circ., November, 1883.*

PSYCHOLOGY.

Intelligence in a Pointer.—Don was a pointer dog, of large experience, that I shot with over forty years ago. At that time the pinnated grouse were abundant in our wild prairies. The birds were more frequently found in particular localities in different parts of the day. They affected the low grounds or swales, where the grass was long, in the heat of the day, and in the morning and evening they resorted to the high, rolling prairie. In a cool, cloudy day they were likely to remain on the high grounds. Don had learned this as well as his master, and when taken into the field it was interesting to observe the dog, when on the prairie, deliberately surveying the ground and then start out and range over the same ground his master would have selected.

This was the result of education and observation, and was not peculiar to Don. I have known many old bird dogs do the same.

But there was one thing which Don had not been taught in training, but which he had adopted of his own notion, as the result of his own reasoning or reflective powers.

When a young bird gets separated from its companions, or it may be is the last of a covey which has escaped the fowling-piece, it is apt to wander a good deal, and the dog may follow its trail for a considerable distance. When pressed it will seek shorter cover if convenient, and there the trail is freqently lost. In such cases I have frequently seen Don hunt about rapidly and irregularly for a short time, and if still unsuccessful he would return to the last point where he could detect the scent, and then commence to hunt in a circle, enlarging the circle by perhaps two feet in the radius, and these were made with wonderful regularity till he had covered the ground for many rods around, if the want of success required it, but he generally found the bird within ten or twelve feet of the starting-point. I once knew him to go over the ground a second time in the same way before he was successful.

Invariably the bird was found to have concealed itself in a deep narrow depression in the prairie.

I repeat that the dog had not been taught, but had adopted it voluntarily, or, it was his own invention.

I never knew any other dog to do this, although a book could be filled with accounts of smart things which bird dogs have been known to do.—*J. D. Caton.*

A Labor-Saving Fish-Hawk.—Audubon, in his Birds of America, remarks (Vol. 1, p. 65, octavo edition), that "A most erroneous idea prevails among our fishermen and the farmers along our coasts, that the fish-hawk's nest is the best '*scare crow*' that can have in the vicinity of their houses or grounds, as these good people affirm no hawk will attempt to commit depredations on the poultry so long as the fish-hawk remains in the country." Whether this is true or not is of little consequence. We all know, however, that they generally build their nests from choice in human vicinity, and never conceal their nests from our view; differing in this respect from most other birds, including some that are domesticated. From Sandy Hook to Cape May is the favorite summer residence of the fish-hawks (*Pandion haliaetus*), there many of their nests may be seen in a single walk along the sea coast.

About fifteen miles north of Cape May, N. J., Silver island

better known as the seven mile beach, appears to be a favorite spot in the breeding season; there, the writer of this article has photographed seven of their nests. All are built on the tops of trees of various altitudes, with one exception, one being built on the roots. The tree is, however, turned upside down, as represented in our sketch as a picturesque object. The founders of that family residence selected the roots of the tree uplifted and forming a basin-like solid foundation, conveniently shaped to save labor in collecting sticks, of which the superstructure is formed, slight additions being sufficient for the cradle of ten generations of young hawks which I have known.

That lone and venerable cedar tree stands in a salt meadow, half a mile from the sea, with its roots high up in the air, while its branches are buried, and hold it to the earth, the effect of some terrible storm of wind or sea (perhaps both), no one knows when as far as I could learn. On the roots of this tree the fish-hawks have annually repaired the nest and raised their families. Now they have abandoned it.

It may not be out of place to remark here that the fish-hawks do not always select a dead tree on which to build, as is generally supposed, almost all their nests being seen on dead trees, but it is a fact that the trees selected almost certainly die, or the upper branches do, in a few years after being so occupied.—*T. R. Peale.*

The Permanence of the Domestic Instinct in the Cat.[1]—That the common cat would return to its primitive feral state, if a company of them of both sexes were turned loose in a region where they could have no access to mankind, is probable, and perhaps certain. But that the domestic instinct has now become an integral characteristic of the species, is a matter that will hardly be questioned by any one. Still opportunities to test the real permanence of this instinct are not often presented. I had the good fortune, however, to meet with an interesting opportunity of this kind, during the prosecution of my field work for the U. S. Geological Survey, in the summer of 1883.

In the prosecution of that work I made the journey, together with my party of three other persons, in an open row-boat, from Fort Benton, Montana, to Bismarck, Dakota, a distance of more than 1000 miles; nearly 600 miles of that journey being through a region which has so few inhabitants that no post-offices were established there. The only white people in the region were a few buffalo hunters, and the woodman who supplied the few passing steamers with fuel, and even these persons were rarely seen upon our journey.

Upon making our camp one night, about 100 miles above Fort Peck, a good sized black-and-white male cat came to the boat, and, although shy at first, soon manifested gratification at meet-

[1]Read before the Biological Society of Washington, Nov. 16, 1883.

ing us. I at first supposed that he belonged to some settler, but upon examining the neighborhood, no trace of the recent presence there of white men could be detected. When we started upon our journey in the morning, we left the cat on shore, but he followed along the bank, mewing piteously to be taken on board. The boat was headed for the shore, and as soon as it touched the bank the cat jumped on board, evincing delight at being in our company. For the next 100 miles he was our companion, and we became very much attached to him. He was extremely neat and never soiled the boat in any respect while we had him. At times he would ask plainly, by such signs as he could command, to be set on shore; and then he would hurry back again for fear of being left. He was gratified with our attentions to him, and purred approvingly when we caressed him.

We would have gladly taken him to Washington with us, but as that was impracticable we decided to leave him at the first place which should seem to offer him a good home. Upon reaching Fort Peck, which is now only an Indian trading post, we found only one white man there, who was in charge of the store. To him we told the story of our cat and begged him to give the wanderer a home. He consented, and upon going to the boat he at once declared our cat to be one which he, in company with a party of buffalo hunters, had, the year before, taken to the place where we had found him. He said the cat was absent, probably on a hunt, when they broke their camp, and so Jerry, for that was the name we had given him, was left there, and had spent the year alone in the wilderness, hunting his own living.

Of course I cannot cannot say that Jerry had not associated with mankind in all that time, but the circumstances favor such a conclusion. If he had, after his abandonment, taken up with any settler, it seems hardly probable that he would have been so eager to join us. He seemed quite conscious that we would take him away from his haunt; and this shows that he had formed no attachment to either persons or locality there. The love of locality is doubtless more observable in the cat than the love of persons; while the reverse is true of the dog. Cats are never so demonstrative in their expression of attachment as dogs; and I suspect that the associations of human domesticity has much to do with the attachment to locality which cats manifest. It is true that Jerry was an unusually intelligent cat; and his case may be a somewhat exceptional one. But I cannot help thinking that there is yet much for us to learn of the psychology of this alleged well-known animal.—*C. A. White.*

NOTE.—Dr. Crichton Browne, Vols. I and II, "West Riding Asylum Reports," states that the greater size of the head in civilized races, unaccompanied by a proportionate increase in the pelvic diameters, is an influence operating to a great extent in the production of idiocy, imbecility and insanity.—*S. V. Clevenger.*

ANTHROPOLOGY.[1]

THE INDIAN CENSUS. — Mr. Sherman Day, in the *Overland Monthly* for November, speaks of the remissness of the census officers with respect to the enumeration of Indians. He has compiled a table of our Indian population which combines the meager returns of the census, the data of the Indian Office, and some investigations of his own, as follows:

States.	*Total, including Ag'cy Indians.*	*Indians outside.*	*Agency Indians.*	*Total Indians.*
Alabama	1,262,505	213		213
Arkansas	802,525	195		195
California	866,342	13,601	4,324	17,925
Colorado	195,252	154	925	1,079
Connecticut	622,700	255		255
Delaware	146,608	5		5
Florida	269,493	180		180
Georgia	1,542,180	124		124
Illinois	3,077,871	140		140
Indiana	1,978,301	246		246
Iowa	1,624,965	466	350	816
Kansas	996,995	815	899	1,714
Kentucky	1,648,690	50		50
Louisiana	939,946	848		848
Maine	648,936	625		625
Maryland	934,943	15		15
Massachusetts	1,783,085	369		369
Michigan	1,646,732	7,249	9,795	17,044
Minnesota	785,155	2,300	4,372	6,682
Mississippi	1,131,597	1,857		1,857
Missouri	2,168,380	113		113
Nebraska	456,341	233	3,939	4,174
Nevada	70,097	2,803	7,831	10,634
New Hampshire	346,991	63		63
New Jersey	1,131,116	74		74
New York	5,087,987	819	5,116	5,935
North Carolina	1,399,750	1,230		1,230
Ohio	3,198,062	130		130
Oregon	179,239	1,694	4,471	6,195
Pennsylvania	4,282,891	184		184
Rhode Island	276,531	77		77
South Carolina	995,577	131		131
Tennessee	1,542,359	352		352
Texas	1,591,857	992	108	1,100
Vermont	332,286	11		11
Virgina	1,512,565	85		85
West Viirginia	618,457	29		29
Wisconsin	1,323,253	3,161	7,756	10,917
Total in States	49,418,560	41,890	49,896	91,786

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Territories.	*Total, including Ag'cy Indians.*	*Indians outside.*	*Agency Indians.*	*Total Indians.*
Arizona	57,661	3,493	17,221	20,714
Dakota	166,273	1,391	31,096	32,487
D. Columbia	177,624	5		5
Idaho	36,862	765	3,652	4,417
Montana	57,864	1,663	18,705	20,368
New Mexico	146,242	9,772	26,677	36,449
Utah	146,334	807	2,371	3,178
Washington	88,219	4,405	13,103	17,508
Wyoming	22,562	140	1,782	1,922
Indian Ter.	79,024	5 tribes other tribes	60,036 18,988	79,024
Total organized Territories	978,665	22.441	193,631	215,072
Alaska (estm.)	33,426	31,250		31,240
Terr. with Alaska	1,012,091	53,681	193,631	247,312
Grand Total	50,430,651	95,571	243,527	339,098

Total Indians without Alaska, States		91,786
" " " " Territories		216,072
" " " "		307,858
" " with "		339,098
Agency Indians, States	49,896	
" " Territories	193,631	
Total agency Indians	243,527	

BRITISH ANTHROPOLOGY.—The Journal of the Anthropological Institute commences each volume with what we call the fiscal year. No. 2 of Vol. XIII appeared in November. The original papers of general import, are as follows:

On some customs of the Aborigines of the River Darling, N. S. Wales. By Frederick Bonney.

The nature and origin of group marriage. By C. Staniland Wake.

Notes on stone implements from S. Africa. By Maj. H. W. Feilden.

Notes on Relics of the sign and gesture language among the Malagasy. By Rev. James Sibree.

On some Australian beliefs. By A. W. Howitt.

On the Botocudos. By A. H. Keane.

The Ethnology of Germany (Part VI), the Barini, Barangians and Franks. Section II. By Henry H. Howorth.

Mr. Bonney speaks from an experience of fifteen years, and repudiates the assertion that the Australians are the lowest type of mankind. Infanticide is practiced from humane motives, the infant immediately after birth being dispatched by the mother's brother, by a blow on the back of the head, strangling with a rope, or choking with sand. The initiation of the youth is painful and tedious, and many seek to defer the day. After its completion the young man may marry. They believe that sick-

ness is caused by an enemy who uses certain charms, and is cured by the doctor practicing the sucking cure. A very sick person or an exhausted traveling companion is fed upon blood supplied from the veins of his friends. The burial customs are exceedingly interesting.

Mr. Wake sums up the later researches on group marriage and seeks to find its cause in two principles. First, sexual conduct is natural, and therefore permissible to all—implying a sexual right in every individual who attains a certain age; and second, sexual unions between persons without certain degrees of consanguinity are criminal.

Mr. Sibree follows up Colonel Mallery's investigations concerning gesture speech by independent researches among the Malagasy.

Mr. Howitt's paper was read by Mr. Tylor. All the tribes believe that the earth is flat, and that the sky is propped up on poles. Beyond the sky is the gum-tree country, the home of spirits and ghosts. Every man has within him a *Yambo*, or spirit, which can leave his body and wander even to the gum-tree country and talk with the spirits there, or converse with the wandering ghosts of other sleepers. The state of departed souls and their doings after leaving the human body fill a great part of Australian mythology. The dead are buried doubled up, the body lying on the side, and the usual deposit is made of the personal effects of the deceased. The author closes with an extended account of ghost-land.

Mr. Ribeiro having visited England with some Botocudo Indians, Mr. Keane took the occasion to explain the habitat and history of the tribe.

The papers of Mr. Howorth are all alike in this, that they belong to what may be called classic ethnology, and exhibit a great amount of close reading and critical study.

German Anthropology.—The fourteenth annual meeting of the German Anthropological Society was held at Trieste on the 9th, 10th, 11th, 12th August of the past year. The president was Professor Virchow, and the general secretary, Dr. Johannes Ranke. In attendance were 302 registered members. The chief attraction of the meeting was the old Roman remains, of which the city can boast the finest. Some of the most important addresses were the following:

Opening speech on the first use of metals. By Professor Virchow.

Trieste and its neighborhood, until the conquest of the Franks. By Dr. Hettner director of the museum.

Yearly progress of Science. By Dr. Ranke. [An excellent summary.]

Anthropological Catalogues. Herr Schaaffhausen.

MICROSCOPY.[1]

MAYER'S METHOD OF FIXING MICROSCOPICAL SECTIONS.[2]—The new fixative proposed by Dr. Mayer is prepared by mixing *the filtered white of eggs with an equal volume of glycerine.*[3] A little carbolic acid may be added as an antiseptic. A very thin and even layer of the fixative is painted upon the object-slide, which is then ready for receiving the sections. After the sections are placed, the slide is warmed a few minutes in the oven of a water-bath, just long enough to melt the paraffine. The paraffine is next dissolved away from the sections by turpentine, the turpentine removed by alcohol, and the sections then colored *in situ* on the slide.

As a coloring fluid, a strong alcoholic carmine is recommended. It is prepared as follows:

Dissolve four grams carmine in 100^{ccm} alcohol (eighty per cent) by boiling about thirty minutes, adding thirty drops of strong hydrochloric acid during the boiling. The solution should be filtered while hot, and the acid carefully neutralized by adding ammonia until carmine begins to be precipitated.

This fluid, which may require to be filtered a second time after cooling, stains uncommonly quick, deep and diffuse. To obtain a differential staining, it is well to stain deeply, and then partially decolor by washing with acidulated alcohol.

The decoloration should be checked at the moment when the film of the fixative become nearly or quite colorless.

PERCHLORIDE OF IRON AS A REAGENT FOR PRESERVING DELICATE MARINE ANIMALS.—In experimenting with a delicate class of marine infusoria (Tintinnodea), Dr. Fol[4] found that the reagents in common use for instantaneous killing, such as picro-sulphuric acid, osmic acid alone or in combination with chromic and acetic acid, and corrosive sublimate, failed to give successful preparations. He finally succeeded with perchloride of iron, a reagent quite new in histological technique. An alchoholic solution diluted to about two per cent will answer ordinary purposes; but a stronger solution should be used in case it is desired to kill a large number of animals in a large vessel. It will not do, however, to turn a saturated solution directly into sea-water, as precipitates would be copiously formed, which would utterly ruin the preparations. After the animals have sunk to the bottom of the vessel, most of the water may be turned off, and seventy per cent alcohol added. In order to remove from the tissues the ferric salts adhering to them, it is necessary to replace this alcohol with alcohol containing a few drops of hydrochloric acid.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

[2] Dr. Paul Mayer. "Einfache Methode zum Aufkleben mikroskopischer."

[3] Glycerine serves to keep the fixative moist while the sections are being placed. Schmitte. Mittheil Zoolog. Station at Naples, IV, p. 521, 1883.

[4] Fol, Beiträge zur histologischen Technik. Zeitschr. f. wiss. Zool. XXXVIII, p. 491, 1883.

The "fixation" of the animals in an expanded life-like form is perfect, and the action of the dilute acid is of so short duration that it causes no injury to the tissues. Not only infusoria and rhizopods, but also large pelagic animals, such as Medusæ, Ctenophoræ, Salpæ, Heteropods, Doliolum, &c., may be thus killed and transferred to alcohol, with their form, histological structure, and cilia perfectly preserved. After complete removal of the yellowish color due to the presence of ferric salts by washing in acidulated alcohol, the tissues of transparent animals remain almost free from cloudiness.

The best method of staining such objects is to add a few drops of gallic acid (one per cent solution) to the alcohol. After twenty-four hours the acidulated alcohol is turned off and pure alcohol added. Thus treated the protoplasm will take a light brown color, the nuclei a much deeper brown. Carmine stains too deeply and diffusely, and cannot be successfully removed.

THE PREPARATION OF DRY INJECTION-MASSES.—The variously colored gelatine emulsions in common use as injections, keep for only a short time, and have therefore to be prepared as occasion arises for their use. The dry emulsions recommended by Fol are very easily prepared and convenient in use. As they will keep for any length of time, they can be prepared in quantities, and thus be ready for use at any moment.

Carmine Emulsion.—One kilogram gelatine (softer kind used in photography), soaked in water for a few hours until thoroughly softened; after turning off the water, heat the gelatine over a water bath until liquified; and then add to it, little by little, one liter of a strong solution of carmine in ammonia. The mixture stiffened by cooling is cut up, and the pieces packed in a fine piece of netting. Vigorous pressure with the hand under water forces the emulsion through the net in the form of fine strings or vermicelli. These strings are placed in a sieve and washed until they are free from acid or excess of ammonia; then collected and re-dissolved by heating. The liquid is poured upon large sheets of parchment which have been saturated with paraffine, and these sheets are then hung up to dry in an airy place. The dried layers of the emulsion, which are easily separated from the parchment, may be cut into strips and placed where they are protected from dust and dampness.

The carmine solution used in this emulsion is prepared as follows:

A strong solution of ammonia is diluted with 3–4 volumes of water, and carmine added in excess. After filtering, the solution is mixed with the gelatine, and then enough acetic acid added to change the dark purple-red into blood-red. It is not necessary to completely neutralize the ammonia.

The dry emulsion requires only to be placed in water for a few minutes and melted over the water-bath, to be ready for use.

Blue Emulsion.—A slightly modified form of Thiersch's formula:

1. To 300^{ccm} of melted gelatine add 120^{ccm} of a cold-saturated solution of green vitriol (ferro-sulphate).

2. To 600^{ccm} of melted gelatine add first 240^{ccm} of a saturated solution of oxalic acid, then 240^{ccm} of a cold saturated solution of red prussiate of potash (potassic ferricyanide).

3. No. 1 poured slowly into No. 2 while stirring vigorously: the mixture heated for fifteen minutes.

4. After cooling, the emulsion is pressed through netting, the vermicelli washed and spread on waxed paper for drying. In this case the vermicelli must be dried directly, as they do not melt well without the addition of oxalic acid.

The dry vermicelli are prepared for use by first soaking in cold water, and then heating with the addition of oxalic acid enough to reduce them to a liquid.

Black Emulsion. — 1. Soak 500 g. gelatine in two liters of water, in which 140 g. of common salt have previously been dissolved, and melt the mass on the water-bath.

2. Dissolve 300 g. nitrate of silver in 1 liter distilled water.

3. No. 2 poured very slowly into No. 1 while stirring. An extremely fine-grained emulsion may be obtained by using 3-4 times as much water in Nos. 1 and 2.

4. No. 3 pressed into vermicelli as above, and then mixed with No. 5 by clear daylight.

5. Mix 1½ liter cold-saturated potassic oxalate with 500^{ccm} of a cold-saturated solution of ferro-sulphate.

6. No. 4 mixed with No. 5 gives a thoroughly black emulsion, which should be washed several hours, again melted and finally poured in a thin layer on waxed paper.

A gray-black emulsion may be obtained by using 240 g. potassic bromide in the place of common salt in No. 1, the remaining operations being the same.

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SCIENTIFIC NEWS.

— The Trustees of Williams College engaged last spring, for a series of years, one of the tables at Dohrn's International Zoological Station at Naples. It has until recently been occupied by Dr. Edmund B. Wilson, a graduate of the Sheffield Scientific School, and of the Johns Hopkins University.

His occupancy of the table illustrates the principles which will guide the authorities of the college in making an appointment to this trust. Any American naturalist, already distinguished for research, may apply for the use of the table by writing to President Carter. And while a graduate of Williams College, of scholarly eminence, will be regarded as having a superior claim, the appointment will, in no case, be given to a

naturalist who does not give evidence of ability to do original work.

It is expected that each occupant of the table will give, soon after his return to this country, a brief course of lectures in the Natural History lecture room, at Williams, on some subject connected with zoölogical work.

The table is now held by Professor Clarke, but it will probably be vacated on or before April 1st, 1884. The successful applicant will be informed of his appointment as soon as practicable after it is made, and the name will be also communicated to *Science* and the AMERICAN NATURALIST, for publication.—*Williams College, Dec., 1883.*

— The camels now running wild in Arizona were bought by the United States Government in Asia Minor. There were seventy-six camels in the first "colony." They were first employed in packing between Fort Tejon and Albuquerque, in some instances carrying 100 gallons of water to the animal, and going nine days without water themselves. Tiring of the camels, the Government condemned them and they were sold at Benicia to two Frenchmen, who took them to Reese river, where they were used in packing salt to Virginia City. Afterwards the animals were brought back to Arizona, and for some time were engaged in packing ore from Silver King to Yuma; but through some cause or other the Frenchmen became disgusted, there being no market for camels just then, and turned the camels loose upon the desert near Maricopa wells, and to-day they and their descendants are roaming through the Gila valley, increasing and multiplying and getting fat upon the succulent sagebrush and greasewood with which the country abounds.—*Tombstone Epitaph.*

— The Puget Sound *Argus* says: "Mount Adams, in Washington Territory, was recently ascended by a large party. They reached an elevation of 12,650 feet. The crater was penetrated a distance of 100 feet. There was a ceaseless drip of water from the roof of the ice-incased entrance, caused by a warm-air current coming from the slumbering fires far below, whence a loud, hissing noise arose. A rock hurled down produced a deafening reverberation." The height of Mount Adams, which is a conspicuous object for a great distance throughout this general region, is stated by Jewett, on the authority of Vansant, at 13,258, and by Petermann at 9570 feet, the latter is probably an error, as it is certainly one of the highest peaks of the Cascade mountains.

— Henry Holt & Co., New York, have recently published Packard's Briefer Zoölogy, as one of their American Science Series, Briefer Course. It is designed for use in grammar and high schools. In part re-written and made simpler than the larger Zoölogy by the same author, portions of that work have been retained, with additions regarding the habits of birds and

common mammals. A number of illustrations, especially of birds and mammals, appear in it not contained in the larger volume. It is a book of 334 pages.

— An admission fee of fifty cents is now charged visitors to the ostrich farm at Anaheim, Cal. The object of the tariff is to discourage the rush of visitors, who seriously interfere with the work of the farm. The birds are breeding and require careful attention and freedom from disturbance.

— Major J. W. Powell is delivering some lectures on Social Evolution before the Philosophical Society of Washington.

— Mr. Robert B. Tolles died Nov. 18, 1883, at Boston. For many years Mr. Tolles held the highest place in America as the manufacturer of microscopic lenses and triplets, as well as other microscopic apparatus, devised by himself. His death is a loss to the scientific world.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Proceedings of the Philadelphia Academy of Natural Sciences.—Oct. 3.—Professor Heilprin discussed the cotemporaneity of geological formations.

Oct. 11.—Rev. Dr. McCook spoke of the parasites infesting the cocoons of spiders. The cocoons of ichneumon flies, of the genus Pezomachus, were found in the cocoons of *Argiope riparia* and *Epeira atrata* of the Pacific coast, but these were in their turn infested by chalcidians. From the cocoon of the last-named species several small beetle larvæ of the genus Trogoderma were also extracted, together with some ants of the genus Solenopsis.

Oct. 18.—Mr. J. A. Ryder described *Gastrostomus bairdii*, a strange fish dredged off the Massachusetts coast at depths of from 500 to 3000 fathoms. A comparison was made between this species and the Eurypharynx of the Mediterranean. In the American form the jaws are still more remarkably developed, so that they are seven times the length of the head. The extensible membrane of the upper jaw, and the pouch pendant from the lower, cause the mouth to be a vast funnel, to which the body seems an insignificant appendage. Probably the food is partly digested, as well as collected and stored, in this receptacle. The gills are placed far behind the skull, the gill-openings are mere pores, the opercular bones are absent; a membranous fold is situated near the tail, and the ova, as in eels, drops directly into the alimentary canal. The eyes are functional.

Nov. 1.—Mr. J. Willcox detailed his observations upon the soil of parts of Canada and New York, and stated his belief that the great glacier had removed the original soil, and in its retreat had deposited the existing coat, always thinner than that to be found

south of the terminal moraine. Professor Heilprin called attention to the presence of fragments of trilobites among fossils from rocks of the Hamilton period in Pike and Monroe counties, where Professor J. C. White had been unable to discover them.

Appalachian Mountain Club.—Dec. 12, 1883.—Report of the councilor of topography, J. R. Edmunds; Nordenskjöld's Greenland expedition, by Professor Wm. H. Niles; Twin Mountain range and valley of the East branch, by R. K. Wood; an ascent of the Giant's Stairs (postponed from Nov. 14); ascents of Mts. Hale, Pliny, and Caribou, by E. B. Cook; a partial exploration of Mt. Wildcat, by Miss M. M. Pychowska.

Special Meeting, Dec. 19.—Optical illusions among the mountains, by Professor Charles E. Fay.

Biological Society of Washington.—Dec. 14.—Papers were read by Professor C. V. Riley on the use of napthaline in medicine and as an insecticide; by Mr. Henry W. Elliott, concerning the appetite of the muskrat; by Dr. R. W. Shufeldt, the anatomical collections of the Army Medical Museum.

Dec. 28.—Communications were presented by Dr. Thomas Taylor on napthaline, its effects on seeds, plants, insects and other animals; by Mr. J. A. Ryder on the structure of the egg-membrane; by Dr. W. S. Barnard some results by *massage et contre coup;* and Mr. Romyn Hitchcock exhibited an improved form of microscope.

New York Academy of Sciences.—Dec. 10.—The following paper was read: The geology, botany, and scenery of the Yellowstone National Park (illustrated with lantern views), by Dr. J. S. Newberry and Professor H. L. Fairchild.

Dec. 17.—The following papers were presented: 1. The literature of ozone and peroxide of hydrogen (second memoir), including: 1. Historical-critical résumé of the progress of discovery since 1879; 2. Index to the literature of ozone, 1879–1883; 3. Index to the literature of peroxide of hydrogen, 1879–1883; II. Facts gathered from eight years of personal inspection, as to the alleged destruction of the Adirondack forests, by Professor Albert R. Leeds.

Boston Society of Natural History.—Jan. 2.—Dr. Kneeland spoke of the cause and consequences of the recent earthquake at Ischia, giving lantern illustrations.

The secretary showed a description and drawing of the "sea serpent" lately seen at Long Branch.

American Geographical Society.—Dec. 17.—Mr. Alfred R. Conkling delivered a lecture entitled "Mexico; her Physical Geography and Resources," illustrated with thirty stereopticon views.

Jan. 8.—Rev. C. C. Tiffany, D. D., delivered a lecture entitled "Norway and the Midnight Sun," illustrated with stereopticon views.

THE SOCIETY OF NATURALISTS OF THE EASTERN UNITED STATES held its winter meeting in Columbia College, New York, Dec. 27 and 28. There was a large attendance of members and a goodly list of papers presented, as will be seen by the titles given below. The meeting was opened by an address by the president setting forth the aims and objects of the organization. The following officers were elected for the ensuing year: President, Professor Alpheus Hyatt, of the Boston Society of Natural History; vice-presidents, Professor H. N. Martin, of Johns Hopkins University of Baltimore, and Professor A. S. Packard, Jr., of Brown University, Providence; secretary, Charles Sedgwick Minot, of Harvard Medical School; treasurer, Professor William B. Scott, of Princeton, and executive committee at large: Professor H. C. Lewis, of the Philadelphia Academy of Natural Sciences, and Lester J. Ward, of the United States National Museum.

A committee was appointed to act with the executive committee in defining what a "professional naturalist" is. A resolution was adopted that the society, recognizing the great importance of a thorough knowledge of modern languages, especially French and German, to students of natural history, regards it as a hopeful sign that a conference of professors in this department is now assembled, and expresses its sympathy with their work. A committee was also appointed to confer with the section of biology of the American Association for the Advancement of Science.

TITLES OF PAPERS READ:

Application of photography to the preparation of natural history figures and charts. By S. H. Gage.

Adaptation of lectures to large classes. By W. H. Niles.

Mode of making models of gigantic Cephalopods. By J. H. Emerton.

Preparation of rock-sections. By James Hall.

On some methods of pursuing teratological researches. By Harrison Allen.

Methods of section-cutting. By E. B. Wilson.

Arrangement of a museum of vertebrates. By B. G. Wilder.

Academies of science. By E. D. Cope.

Use of pure carminic acid in staining. By G. Dimmock.

Bleaching skeletons by peroxygen of hydrogen; skeleton holder. By S. H. Gage.

Instruction in mineralogy and petrography. By M. E. Wadsworth.

Arrangement of minerals in museums. By H. C. Lewis.

Methods of mounting museum specimens for exhibition. By A. Hyatt.

Good and bad timber. By J. T. Rothrock.

Evolution and histology. By C. S. Minot.

Preparation of organs. By B. G. Wilder.

Biology in the Northwest. By W. Trelease.

Necturus for laboratory use. By B. G. Wilder and J. H. Gage.

Immersion apparatus. By Alexis Julien.

Museum administration. By G. B. Goode.

Method of lecturing to large classes. By A. S. Bickmore.

Various methods of carmine staining. By B. Sharpe.

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THE CRAB PARASITE, SACCULINA.

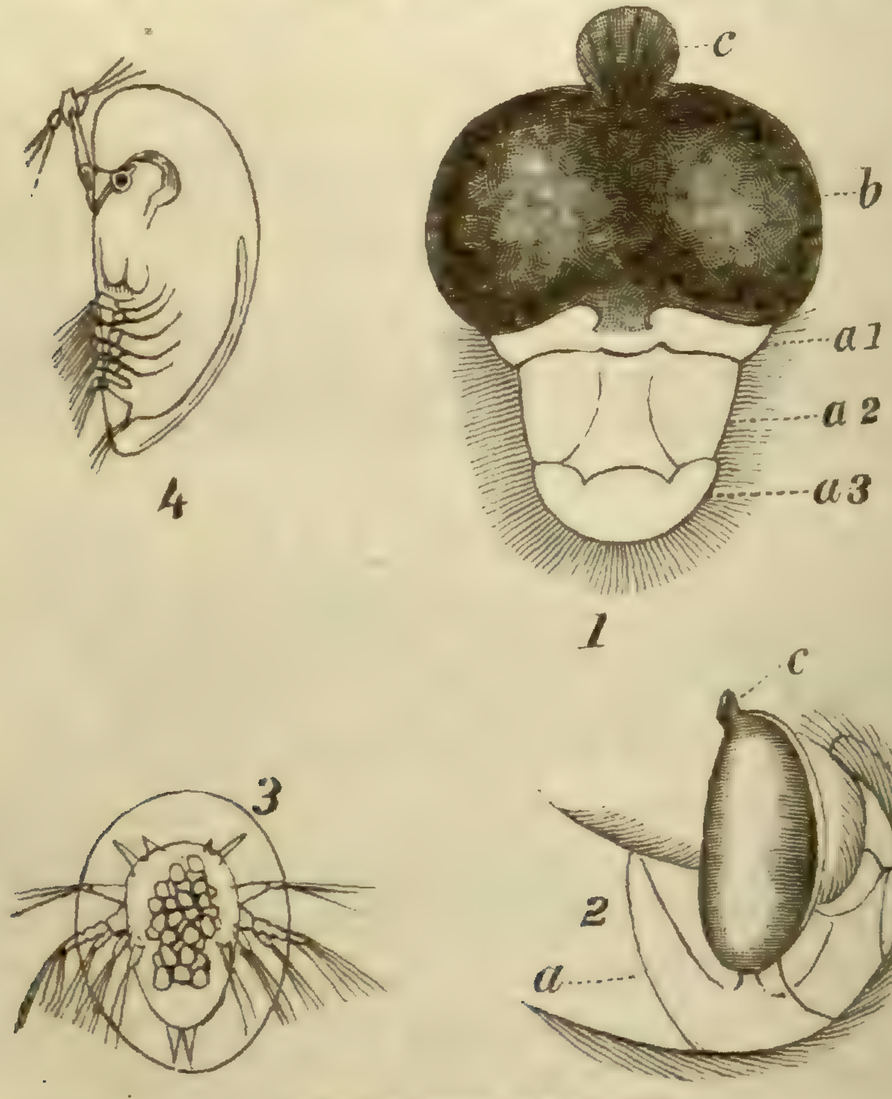
BY CARL F. GISSLER.

SOME three years ago I received a small number of crabs, preserved in alcohol, that had been collected by Dr. Van Elsen in the neighborhood of Tampa, Hillsboro county, Fla. The scientific name of the crab is *Panopæus herbstii*, described by A. Milne-Edwards, a crustacean which has been introduced from farther south, Key West, the West Indies and Brazil, where it occurs most abundantly. Once in a great while an occasional straggler from those southern waters is found on the shores of New Jersey, Long Island and Connecticut. Three other species of the genus Panopæus permanently occur from Florida up to the New England States, *Panopæus harrisii*, *P. depressus* and *P. sayi*. Our *P. herbstii* is easily distinguished from the other three species, as taught by Professor S. I. Smith, of Yale College, "by a tubercle on the sub-hepatic region, just below the first lobe of the antero-lateral border of the carapax, also by the post-orbital tooth being separated from the second tooth of the antero-lateral margin by a rounded sinus, and by the dactylus of the larger cheliped having a stout tooth near the base within." It is well known that all these Panopæus species largely contribute to the food of many marine fishes.

So much for the Panopæus. But our *P. herbstii* does not so much interest us at present as does its enemy, which is also a crustacean, living parasitically on its host. It does, however, not parasitize in the gill-cavity of its host, as is the case with the parasite Bopyrus infecting the common shrimp of our shores,[1]

[1] *Scientific American*, Vol. XLV, September 3d, 1881, p. 151.

but occurs on the ventral surface of the abdomen of its host. The scientific genus-name of our parasite is Sacculina, and by calling it specifically *Sacculina panopæi*, we honor both parasite and host. In systematic zoölogy this Sacculina belongs to the family Rhizocephala, and these again are classified among the barnacles or cirripeds, which the earlier zoölogists regarded as mollusks, but which, in reality, are crustaceans and relatives of the lobster, shrimp and crab. Sacculina is one of the most striking examples of animal degeneration. Fig. 3 illustrates the



EXPLANATION OF FIGURES.

FIG. 1.—*Sacculina panopæi*, female enlarged (male unknown). Ventral view. Color brownish.

c, abdominal, sub-segmented portion.

b, thoracic portion, the sac filled with eggs.

a^1, a^2, a^3, the last three segments of ventral surface of abdomen of *Panopæus herbstii*.

FIG. 2.—*Sacculina panopæi*, female, enlarged. Lateral view.

a, abdomen of *Panopæus herbstii*.

c, abdominal portion with sexual orifice.

FIG. 3.—Nauplius stage of *Sacculina purpurea*. (After Fritz Müller.)

FIG. 4.—Pupa stage of *Lepas australis*. (After Darwin.[1])

[1] Chas. Darwin. A monograph of the sub-class Cirripedia, 2 Vols., London, 181–54.

youngest or so-called *Nauplius* stage of another Sacculina, *S. purpurea.* It is a free-swimming, active larva, has neither eyes nor mouth; its "*cypris*" and pupa stage,[1] differs from the same of the near allied barnacles by the absence of the paired eye on the ventral surface of the head, Fig. 4.

In another later paper[2] I have described and figured the "embryo" of the Bopyrus infecting the common prawn, calling that "embryo" the highest and most advanced stage in the development of Bopyrus, which, under favorable circumstances, will enter the gill-cavity of the earlier developmental stages of the prawn, where it, as the prawn advances in growth, will, when a female, lose its eyes, both antennæ, the uropods, etc.; while the pleopods will degenerate into the abdominal lobes and from the seventh free segment will bud a pair of legs. What a clumsy and helpless creature the adult female Bopyrus is, may be learned from the description and illustration given by me in the two journals cited. But our Sacculina is much more degenerate, it is the most utterly reduced parasite known. Its body is a mere sac (measures $2\frac{2^{mm}}{5}$ in thickness, 6^{mm} in width and $4\frac{3^{mm}}{5}$ in length, figs. 1 and 2), of kidney shape, convex anteriorly, posteriorly concave in the middle and filled with a great number of minute eggs. Its lower constricted portion is securely attached by a short stem, like a barnacle, to the third last segment on the ventral surface of the abdomen of (in this case a female) *Panopæus herbstii*, which abdomen, upon dissection, exhibits a large number of branched tubes, originating from the stem of the parasite and distributing over and entangling the intestinal tract of the crab, thus endosmotically absorbing nourishment from the same. Some of these tubes terminate blind, others form delicate plexuses. At the upper constricted portion of the bag we notice a small, roundish, fleshy piece, flattened antero-posteriorly. It has some resemblance to the fog-pipe of a steamer. Its posterior surface is convex and sub-segmented into seven parts. It measures $1\frac{2^{mm}}{5}$ in width and $1\frac{1^{mm}}{5}$ in length. Its anterior surface is concave and provided at its lower half with a minute opening, the sexual orifice. The convex surface of the sac I presume to be the dorsal side, and the opposite, the concave, I take for the ventral side of the animal. The upper smaller part, resembling a fog-pipe, is the

[1] *Idem.*

[2] AMER. NATURALIST, Vol. XVI, January, 1882, pp. 5–12.

abdominal portion, and its segments are the remainder of the swimming legs of the pupa stage. The main body, the sac, is the thoracic portion of the former pupa. The cause for so reasoning is the supposed existence, in Sacculina, of what is known under the name of "dorsal organ" in the young of a great many crustaceans, even if such a structure has not yet been discovered among Rhizocephala. The peculiar attitude of the pupa stage in barnacles in the act of permanently attaching themselves to some marine object, tends to an assumption of analogy. I have repeatedly seen the "dorsal organ" and noticed its use in the young of branchipod crustaceans (Eubranchipus, Streptocephalus, Apus, Chirocephalus, Limnetis, etc.) in attaching themselves to the walls of the breeding jars in which they were kept. This organ appears to be of a glandular nature, is situated in most cases in the occipital region, is strikingly large in the young of some crustaceans, and gradually degenerates in the further development, but persists in some forms. The pupa of Sacculina may attach itself head foremost by means of the "frontal or dorsal organ" to the abdomen of Panopæus, the mouth and antennæ subsequently degenerate, the intestinal tract develops into a number of cœcal appendages, the latter enter the host, and the swimming feet, or cirri, are lost. The thoracic portion, or sac, is composed of an outer very tough skin and an inner more delicate membrane. This sac presents an analogy to the "marsupium" or breeding cavity of Bopyrus, for in it the eggs are hatched and protected until better fit to leave the mother animal. A constant current of sea-water between these two skins may probably exist for the aëration of the young; the entrance and exit for the water must, if there is no other opening, be through the sexual orifice. May not the extraordinary mode of obtaining nourishment render both parasite and host, physiologically considered, so to speak, but one animal? May not thus a condition be effected largely contributing to an oxygenation of the circulating fluid of Sacculina, a mere combination, as it were, of that of Panopæus? The "division of labor" in circulation, respiration and nourishment may be going on, in spite of the apparent absurdity, in certain more or less differentiated individuals of those appendages or tubes. The question, What is degeneration due to as exhibited in Sacculina? we answer it is due to two causes: first, being a near relative of the barnacles, it is due to the metamor-

phosis of the Nauplius into a pupa and subsequently into an animal of a sessile and immobile habit of life; second, it is due to parasitism (Symbiosis). An approximate stability of the present form of Sacculina is maintained by the important law of heredity, very slow changes in color, form, etc., will, however, make their appearance by changes of climate and immediate surroundings, *i. e.*, the host. In concluding, let me quote from E. Haeckel: "The series of forms which the individual organism passes from the egg up to the development of the adult form is but a brief and rapid recapitulation of the series of forms, which all the ancestors of this organism have passed since the beginning of the organic history of the earth down to the present day. This repetition or recapitulation is conditioned through the laws of heredity and modified through the laws of adaptation. The historical record, preserved in the developmental history of the individual, is rendered gradually obliterate, the development gradually taking a more and more direct course from the egg up to the adult, and it is also often falsified through the struggle for existence which the free-living young are subject to. The falsification of the ontogenetic product is conditioned through the law of the modified or falsified heredity."

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MEN IGNORANT OF FIRE.

BY TITIAN R. PEALE.

IN theory, mankind differs from all other animals in the habit of cooking his food by the means of *fire*, which, in the progress of civilization, has improved so much as to become a science. Hence there are many grades of progress to be observed between the savage and the civilized man; and hence there are many facts worthy of record by the intelligent traveler, relative to the use of fire. I do not know of any but a single record where natives of a *newly* discovered country did not know the *use of fire;* that one case was on Island *Famua Loa*, or Bowditch's island, discovered on the 29th of January, 1841, by the U. S. S. *Peacock*, commanded by Capt. W. H. Hudson, of the U. S. South Sea Surveying and Exploring Expedition (see Narrative by Ch. Wilkes, Vol. v, p. 10).

Captain Hudson relates: "The natives were at first very shy of the boats; but the Hawaiians who were in them soon induced them to approach, and to enter into trade, and finally enticed

them alongside the ships. On coming near they began a song or chant, holding up their paddles and mats, and shouting, 'kafilou tamatau.' They resembled the natives of Oatafu, or Duke of York's island, wore the same kind of mats, eye-shades and ornaments, and some were tatooed in the same manner. Some, however, were tatooed in a different style, being ornamented with a variety of arrows on the forehead and cheeks. They were all finely formed and manly in appearance, with pleasing countenances that expressed good nature.

"They were eager enough for trade, and soon disposed of all they had to exchange; a few presents were made them, but all inducements failed to entice them on board. They appeared cheerful, laughing heartily at anything that struck them as ridiculous. * * * * * * * * * *

"The population of this island is estimated to be about six hundred souls, most of whom dwell in the town.

"There were no signs of places for cooking, nor any appearance of fire, and it is believed that all their provisions are eaten raw. What strengthened this opinion was the alarm the natives felt when they saw the sparks emanating from the flint and steel and the emission of smoke from the mouths of those who were smoking cigars."

The writer of this article was on board the *Peacock*, and can vouch for the verity of Captain Hudson's account of our interviews with the natives, and also that they eat their entire food without cooking, but also had the greatest dread of fire in any form. We saw no traces of charcoal or ashes in their village or town, and we fully understood them as to their food, and how it was taken. It consisted entirely of cocoanuts and pandanus fruit, fish, echini, and other products of the sea; the few sea birds mostly seen there, were not regarded as food, and even if they were, could not have been easily obtained or relied on for supplies, the population being large in proportion to the island's size.

In many of the semi-civilized islands of the Pacific ocean uncooked fish are still eaten as a delicacy; also echini, or sea eggs, as we eat oysters, raw, or "in the shell."

The terror of fire, as we witnessed it on more than one occasion at Bowditch's island, convinced us fully that down to the period of our visit the natives had never cooked their food; fish was not abundant on any of the coral islands or attols, and fish were plenty and relished when not cooked. We saw a kind of half cooking at the Paumotu archipelago of fish, to preserve them for transportation to the Island of Tahiti.

The natives of Fanua Loa, when discovered, were quite ingenious in the construction of houses, canoes, and various fishing implements, mats, &c., considering the total absence of all metals, their island being of coral formation, and their having no communication with any other.

The various boxes, bowls, stools, &c., carved from the solid wood with sharks' teeth, and smoothed with coral and shark-skin files, were obtained and brought home, and formed a part of the nucleus of the National Museum in the Smithsonian Institution at Washington, where they now hold a place in the Ethnological Department; but, strange as it may appear, some wag, more learned than wise, wrote on a box containing fishing implements the words, "Tinder box," to contradict the statement by Captain Hudson, in Wilkes' published journal—a practical joke, no doubt, but one that should never have been tolerated by those in charge of the public specimens in a national museum.

That cold meals agreed with the Fanua Loans was evidenced by their appearance—they were a handsome people. When we visited them in January, 1841, they were living anterior to their "stone age;" no one of them, it is probable, had ever seen a stone, or a stone implement of any kind; the smallest stone to them would have been as great a curiosity as a *coral tree* would be to a Dakota Indian on our prairies! Their hardest edge tools were made of sharks' teeth or chama shells, yet their carving was not bad; their canoes, stools and boxes, &c., were neatly smoothed with sharks' skins on wooden handles, forming rasps of various shapes to suit the work to be done. They had a well, and a sea wall built of coral rock.

We obtained from them very neatly plaited rush mats used for clothing, &c., but saw no tapa or bark cloth, so common on the volcanic islands of the Pacific ocean.

The thunder of our cannon, when measuring the island by sound, when explained to them, did not create half the alarm created by a lighted cigar, which in their understanding could not bear any explanation, and no persuasion on either of our visits could induce them to approach it.

Now, after forty-two years, and when foreign missionaries have dwelt there, this plain statement of a little fact about fire, will perhaps be as new at Fanua Loa as similar facts will be about cannibalism on other islands where they have been taught to con-

sider it disgraceful to their ancestry. But facts are always of interest in the history of any people, however civilized they may become.

The natives of most of the Polynesian islands, I believe, are willing and capable of the highest grade of improvement in civilization, under proper treatment by nations of greater power and higher mental attainment.

——:o:——

GRAVE MOUNDS IN NORTH CAROLINA AND EAST TENNESSEE.

BY DR. CYRUS THOMAS.

BELIEVING that the description of a new class of grave mounds recently found in North Carolina and East Tennessee, may be of interest to the readers of the AMERICAN NATURALIST, I send by permission of the chief of the Bureau of Ethnology, the following extract from my report of the mound explorations of the past season.

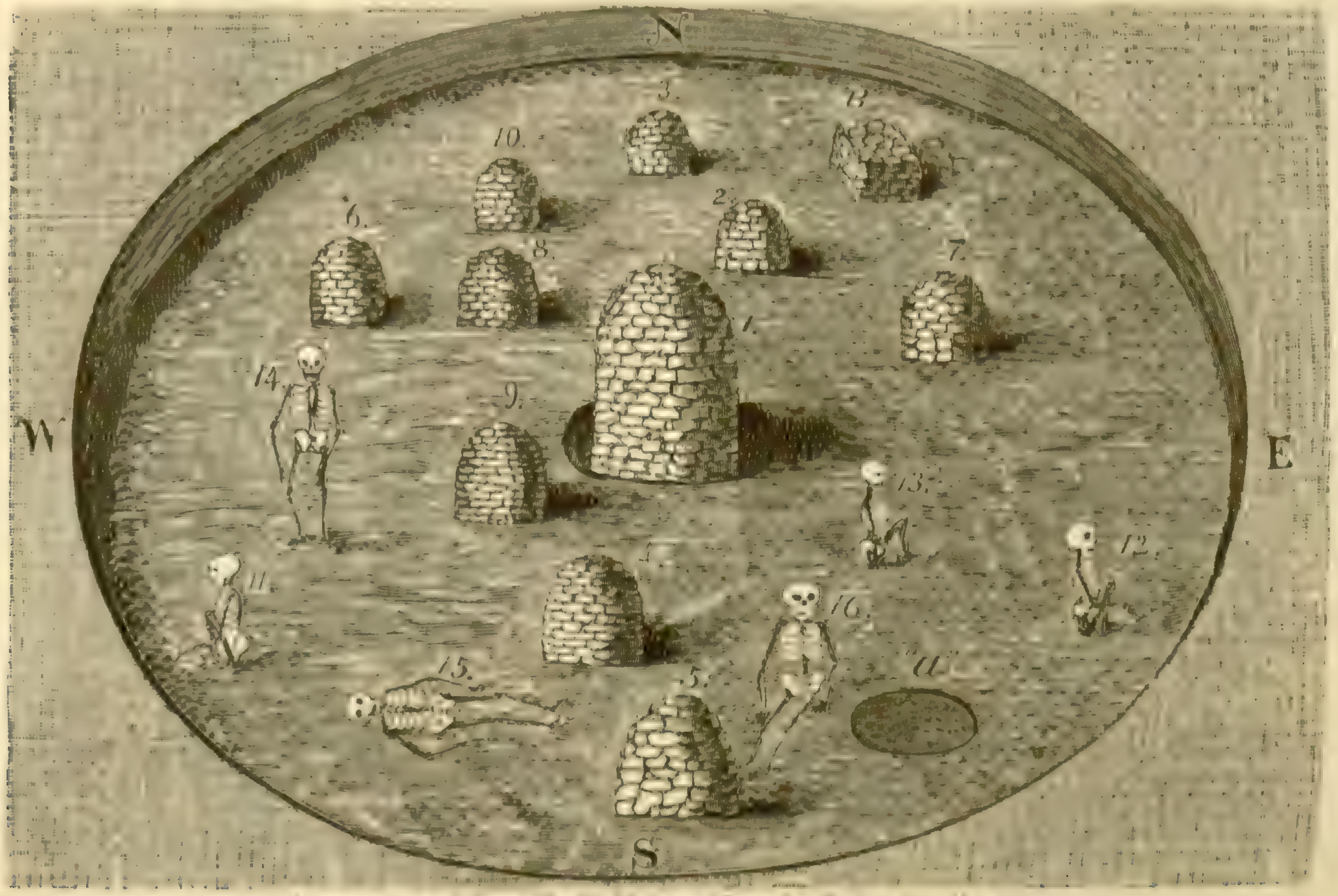
"*The Nelson Mound.*"—This mound, so insignificant in outward appearance as scarcely to attract any notice, was located (for it no longer exists) on the farm of Rev. T. F. Nelson, in Caldwell county, N. C., on the bottom land of the Yadkin, about one hundred yards from the river bank. It was almost a true circle in outline, thirty-eight feet in diameter, but not exceeding at any point eighteen inches in height. The thorough excavation made revealed the fact that the builders of the mound had first dug a circular pit, with perpendicular margin, to the depth of three feet, and thirty-eight feet in diameter, then deposited their dead in the manner hereafter shown, and afterwards covered them over, raising a slight mound above the pit.

A plan of the pit, drawn at the time (after the removal of the dirt), showing the stone graves and skeletons, is given in Plate VII.

The walled graves or vaults and altar-shaped mass were built of water-worn boulders and clay or earth merely sufficient to hold them in place.

No. 1, a stone grave or vault standing exactly in the center of the pit. In this case, a small circular hole, a little over three feet in diameter and extending down three feet below the bottom of the large pit, had been dug, the body or skeleton placed perpendicularly upon its feet and the wall built up around it from

PLATE VIII.



Appearance of Rev. T. F. Nelson Mound, after excavation.

the bottom of the hole, converging, after a height of four feet was reached, so as to be covered at the top by a single soapstone rock of moderate size. On the top of the head of the skeleton, and immediately under the capstone of the vault, were found several plates of silver mica which had evidently been cut with some rude implement. Although the bones were much decayed, yet they were retained in position by the dirt which filled the vault, an indication that the flesh had been removed before burial, and the vault filled with dirt as it was built up.

Nos. 2, 3, 4. 5, 6, 7, 8, 9 and 10, although walled around in a similar manner, were in a sitting posture on the bottom of the pit. In the grave of No. 2 was found a polished celt; in that of No. 3 a single discoidal stone; in that of No. 6 two polished celts, and immediately over No. 9 a pitted stone.

Nos. 11, 12 and 13 are three skeletons in a squatting posture with no wall around them, and unaccompanied by relics of any kind.

Nos. 14 and 15 are two unenclosed skeletons lying horizontally at full length. With the former some pieces of broken soapstone pipes were found, and with the latter one polished celt.

No. 16, an unenclosed squatter, was of unusually large size, not less than seven feet high when living. Near the mouth was an uninjured soapstone pipe; the legs were extended in a south-east direction upon a bed of burnt earth.

The faces of all the squatting skeletons were turned away from the standing central one.

At "*a*" was found a considerable quantity of black paint in little lumps which appear to have been molded in the hull of some nut. At "*B*" was a cubical mass of water-worn boulders, built up solidly and symmetrically, twenty-four inches long, eighteen inches wide and eighteen inches high, but with no bones, specimens of art, coal, ashes, or indications of fire on or around it. On the contrary, many of the stones of the vaults and the earth immediately around them bore unmistakable evidences of fire; in fact the heat in some cases left its mark on the bones of the enclosed skeletons, another indication that the flesh had been removed before burial, either by previous burial or otherwise.

Scattered through the dirt which filled the pit were small pieces of pottery and charcoal. The bottom and sides of the pit were so distinctly marked that they could be traced without difficulty.

This mound stood about seventy-five yards south of a triangular burial-pit described elsewhere.

"*The Jones Mound.*"—This mound, situated on the farm of Mr. W. D. Jones in the same county, was found, upon investigation, to be similar in form and construction to that just described. It was circular, thirty-two feet in diameter and but one foot in

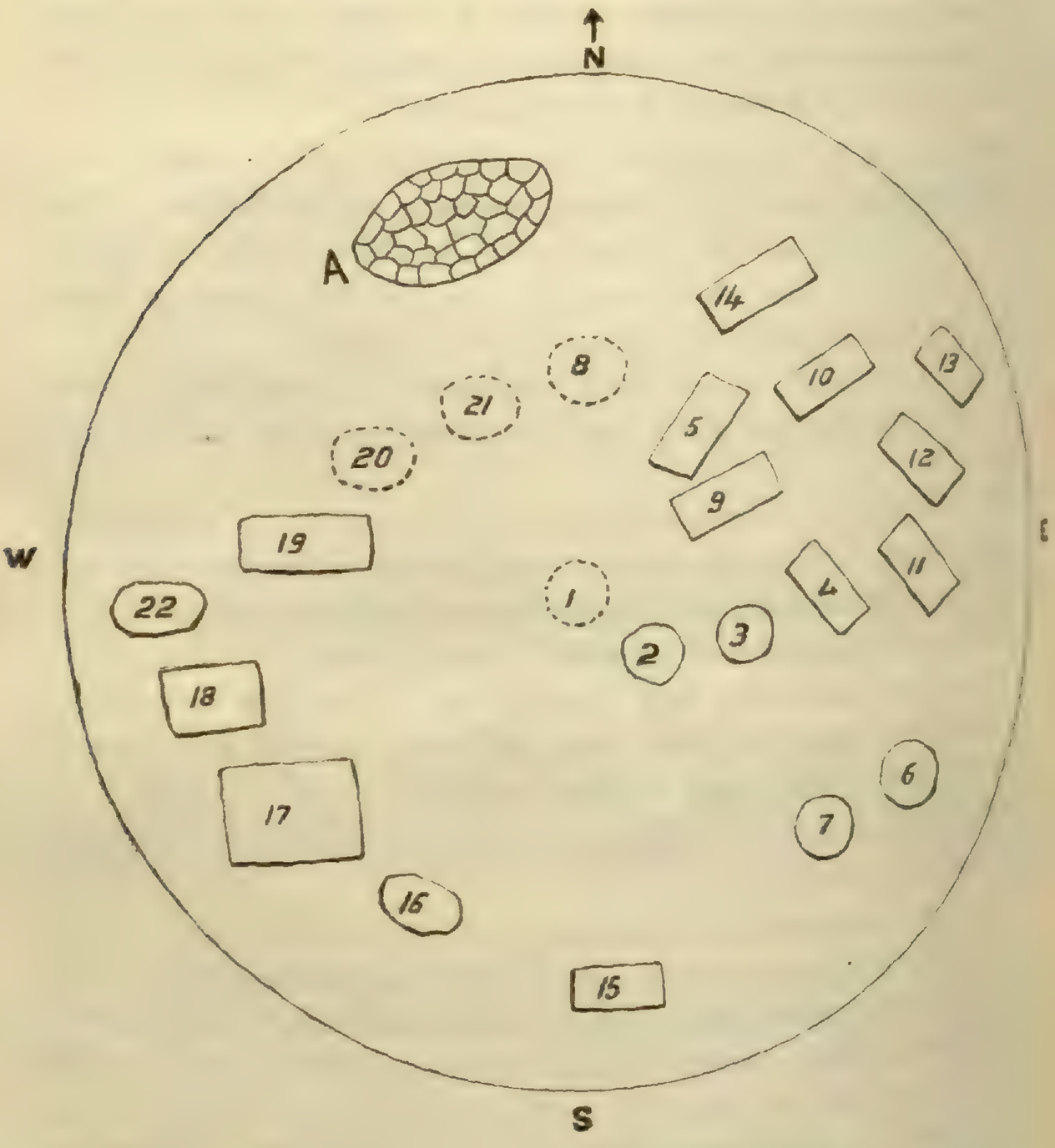


FIG. 1.—W. D. Jones Mound, Caldwell county, N. C.

height; the pit was also circular, thirty-two feet in diameter and three feet deep. The bottom in this case was of clay which had been baked hard by fire to the depth of two or three inches.

In this mound were found twenty-five skeletons and one stone heap, the relative positions of which are shown in Fig. 1.

No. 1. A "squatter," walled in with water-worn stones; the face turned toward the west; no relics.

No. 2. Sitting with the face toward the center; two polished celts at the feet, and immediately in front of the face a cylinder of hard gray mortar (not burned), about five inches long and two inches in diameter with a hole through one end.

No. 3. Sitting, with the face toward the center; several polished celts at the feet.

No. 4. Horizontal, head southeast, several celts at the feet.

No. 5. Horizontal, head toward the center; several celts at the feet.

No. 6. Facing the center, sitting; shell beads around the neck, a Unio shell on top of the head with the concave surface down, a "conch shell" (*Pyrula perversa*) in front of the face, and celts at the feet.

No. 7. Sitting, facing the center, celts at the feet.

No. 8. Very large, lying on the left side, legs partially drawn up, walled in with boulders; no implements.

No. 9. Horizontal, face down, head toward the center, celts and discoidal stones at the feet, and a pot resting, mouth down, upon the head.

No. 10. Horizontal, face up, feet toward the center, pot resting on the face, stone implements at the feet.

No. 11. Horizontal, head south-east, arms extended and a bracelet of copper and shell beads (alternating) around the neck; face up with a food cup (without handle) at the right side of the head.

No. 12. Horizontal, face up, head south-east, shell beads around the neck, a hook or crescent-shaped piece of copper on the breast and a soapstone pipe near the face. One hand near each side of the head, each grasping small conical copper ornaments (ear drops) and a small bunch of hair. Was this individual, possibly a female, buried alive?

No. 13. Horizontal, on the back, head south-east, copper and shell beads around the neck and wrists, a hook or crescent-shaped piece of copper on the breast, a food cup (with handle) lying on its side with the mouth close to the face, a pipe near the mouth and two celts over the head.

No. 14. Horizontal, lying on the back, head north-east, arms extended, each hand resting on a shell which had evidently been engraved, though the figures were almost totally obliterated.

No. 15. Horizontal, on the back, head west, knees drawn up, stone implements at the feet.

No. 16. Too much decayed to determine the position.

No. 17. Four skeletons in one grave, horizontal, heads toward the east and large rocks lying on the legs below the knees; no implements.

No. 18. Two skeletons in one grave, heads west, faces down, knees drawn up; no implements.

No. 20. Sitting, with face toward the east, walled in, a large rock lying on the feet (though this may have fallen from the wall); no implements.

No. 21. Sitting, walled in, over the head, but under the cap-stone of the vault, a handful of flint arrow-heads.

No. 22. Doubled up with the head between the feet.

"*A.*" A solid mass of boulders, oval-shaped, thirty-two inches long, twenty-two inches wide and twenty-four inches high, resting on the bottom of the pit. No ashes or other indications of fire about it.

Fragments of pottery, mica, galena, charcoal, red and black paint and stone chips were found scattered in small quantities through the earth which filled the pit. All the celts were more or less polished.

"*The Lenoir Burial Pit.*"—This is a circular burial pit similar to those described, but level on the surface. It is on the farm of Mr. R. T. Lenoir, same county. A diagram is given in Fig. 2. Diameter twenty-seven feet, depth three and a half feet, almost a perfect circle, sides nearly perpendicular. The dirt in this case, as in the others, was all thrown out.

No. 1. A bed of charred or rather burnt bones, occupying a space three feet long, two feet wide and about one foot deep. "The bones were so thoroughly burned that it was impossible to determine whether they were human or animal." Beneath this bed the yellow sand was baked to the depth of two or three inches. Under the bones was a shell gorget.

No. 2. A skeleton in a sitting posture facing north-east, a pipe near the mouth and a polished celt over the head.

No. 3. Sitting, facing east, with shell beads around the neck and also around the arms just below the shoulders.

No. 4. Horizontal, on the back, head east and resting on the concave surface of an engraved shell, "conch shell" (*Pyrula perversa*), at the side of the head, and copper and shell beads around the neck.

No. 5. Horizontal, head north-east, shell beads around the neck and two discoidal stones and one celt at the feet.

No. 6. A communal grave containing at least twenty-five skeletons, in two tiers, buried without any apparent regularity as to direction or relative position. Thirteen of the twenty-five were "flat-heads"—"that is, the heads running back instead of up in the ordinary way."

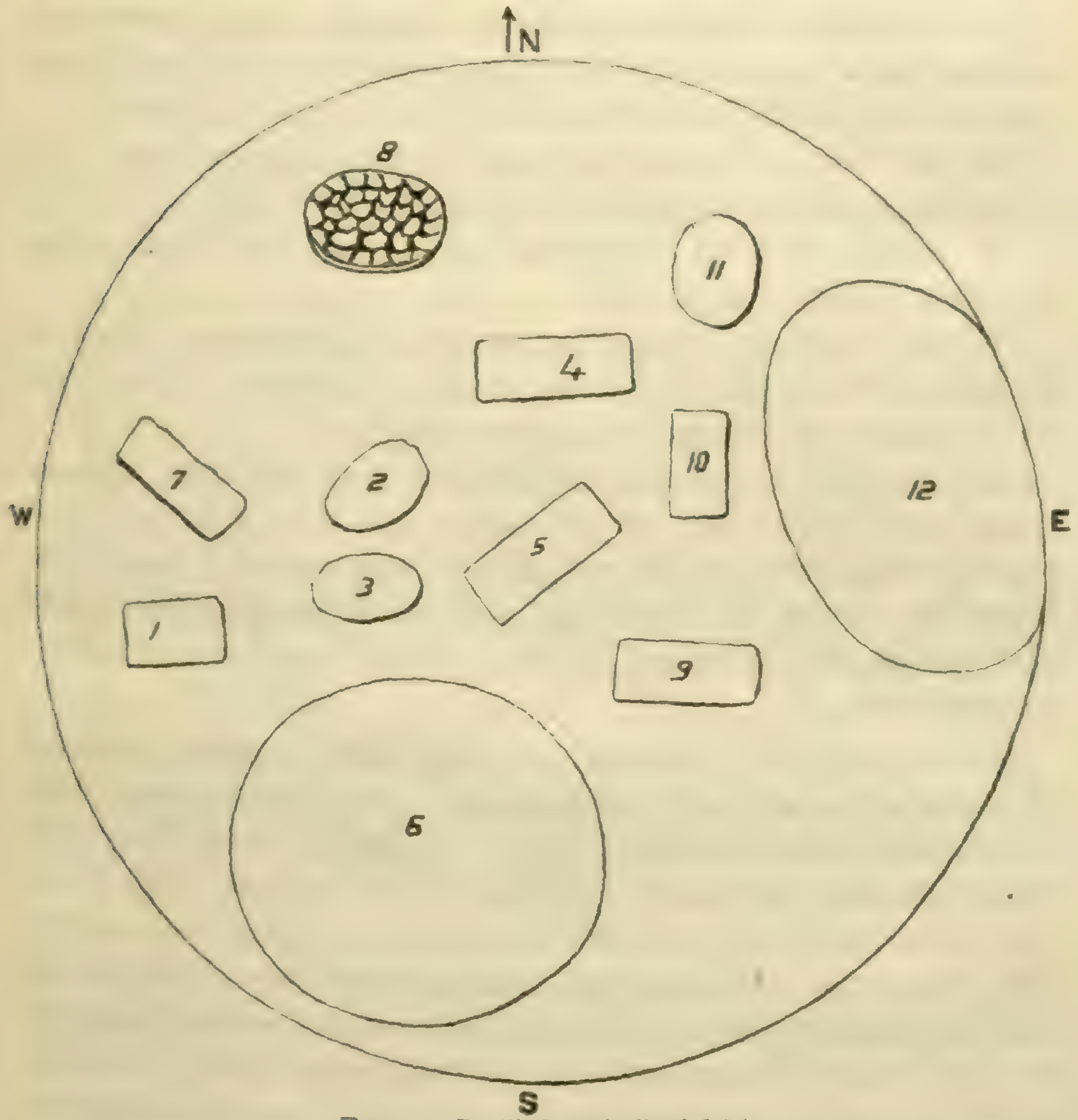


FIG. 2.—R. T. Lenoir Burial Pit.

Scattered through this grave, between and above the skeletons, were polished celts, discoidal stones, shells, mica, galena, fragments of pottery and one whole pot. Around the neck and wrists of some of the skeletons were also shell beads. There may have been more than twenty-five individuals buried here, this, however, being the number of skulls observed.

No. 7. Horizontal, on the left side, head north-east; no implements.

No. 8. An irregular layer of water-worn stones about four feet square. On top was a bed of charcoal three or four inches thick, on and partially embedded in which were three skeletons, but showing no indications of having been in the fire. Scattered over these were discoidal stones, one small saucer-shaped dish, shells (one of which is engraved), pipes, shell beads and pieces of pottery.

No. 9. A grave containing three skeletons, lying horizontally on their backs and side by side; the outer ones with their heads east and the middle one with the head west; no implements.

No. 10. Horizontal, on the right side, head north, with stone implements in front of the face.

No. 11. Doubled up, top of the head south, shell beads around the neck and celts at the feet.

No. 12. A grave containing seventeen skeletons, seven of which had flat heads, two of the number children. Two of the adult heads were resting on engraved shells.

In this grave were found four pots and two food cups, the handle of one representing an owl's head and that of the other an eagle's head. One of the small pots was inside a larger one. Scattered among the skeletons were shell beads, polished celts, discoidal stones, paint, &c. None of the skeletons were enclosed in stone graves.

For the purpose of comparison I will now give the description of a single mound found on the bank of the Holston river, Sullivan county, East Tennessee. It is circular in form, thirty-eight feet in diameter and five feet high; on the top was a pine stump fourteen inches in diameter, the tree having been cut down twenty-five years ago. This mound differed from those described in having no pit below it; but in it, built on the natural surface of the ground, was a circular wall of cobble stones, three feet high, enclosing a space fourteen feet in diameter. Inside of this were twelve stone graves similar to those shown in Plate VIII, one of them in the center and the other eleven equally spaced around near the wall, as shown in Fig. 3.

The surface of the area enclosed by the circular wall was covered to the depth of three inches with charcoal and the graves built on this layer.

Each grave contained a single sitting skeleton; around the neck of the central one were shell beads, and near the mouth a

finely polished pipe of green syenite; no relics were found in any of the other graves.

It is only necessary to add that these mounds and burial pits were opened by the regular assistants of the Bureau of Ethnology, and that all the articles mentioned, except the skeletons, are now in the National Museum. Some of the skulls have also been received, but most of the skeletons were so badly decayed that when exposed to the air they crumbled to pieces.

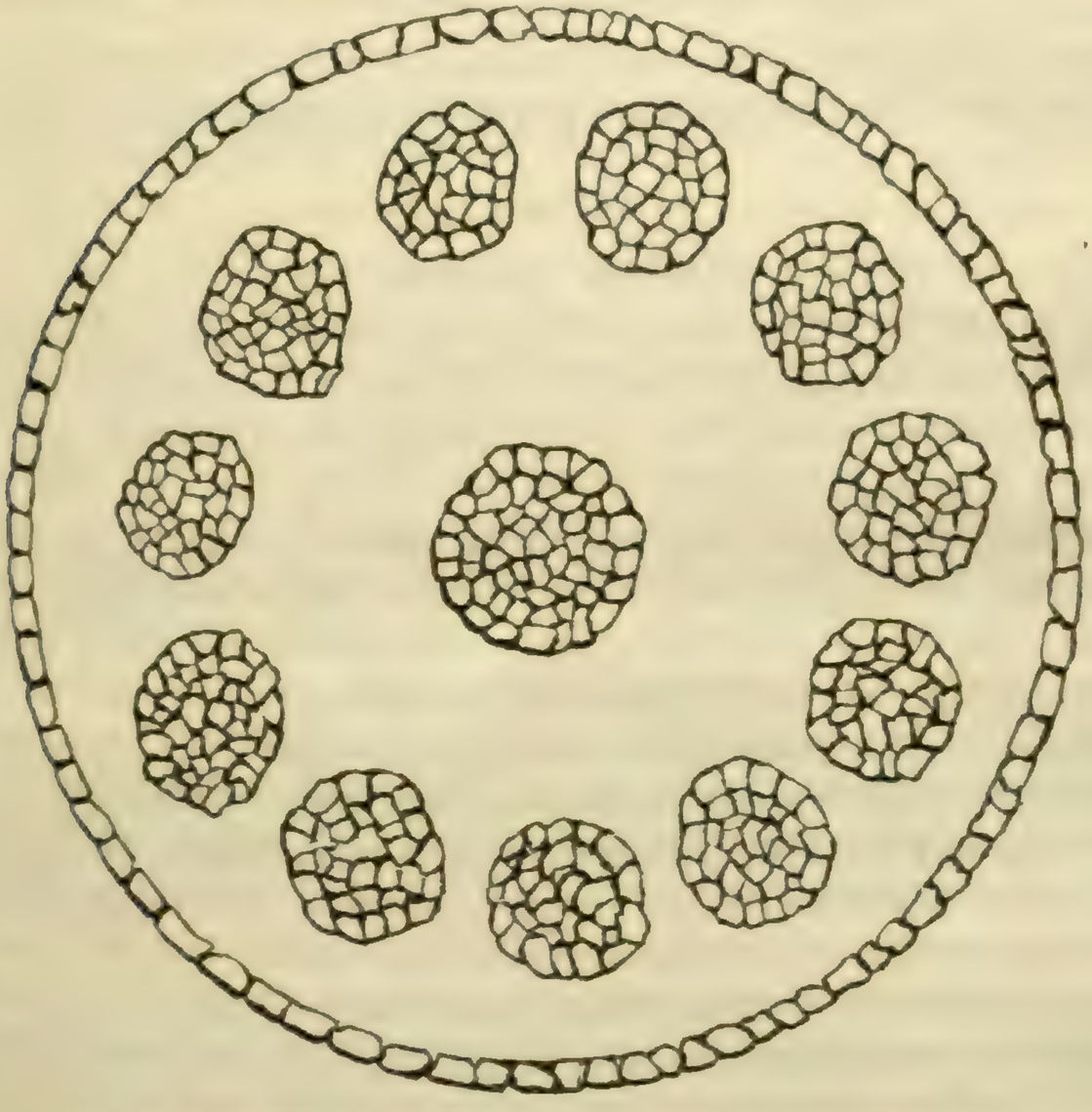


FIG. 3.—Mound on Holston river, Sullivan county, Tenn.

I give here a list of the articles obtained from one of these burial places, the "Lenoir Burial Pit":

One stone axe; forty-three polished celts; nine vessels of clay; thirty-two arrow-heads; twenty soap-stone pipes, mostly uninjured; twelve discoidal stones; ten rubbing stones; two hammer stones; one broken soapstone vessel; six engraved shells; four shell gorgets; one *Pyrula perversa* entire, and two or three broken ones; one iron celt; five very large copper beads; one lot of fragments of shells, some of them engraved; a few rude shell pins;

shell beads; a few small copper beads; specimens of paint and plumbago; three skulls.

I am inclined to believe that these mounds are the work of the Cherokees, but cannot give my reasons for this belief in this article. Somewhat similar burials found in Kentucky point to the region of the Ohio as the former home of the builders of the North Carolina and East Tennessee mounds. It is possible, therefore, that further research will tend to confirm the Cherokee tradition mentioned by old John Lederer.

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COLONIAL ORGANISMS.

BY CHARLES MORRIS.

(Continued from page 149.)

A CONTINUED review of the subject of animal colonization leads next to the Annelida and the Arthropoda as its most advanced instances. This progression, indeed, is not so strongly marked in the Annelida, which are usually not only distinctly segmented, but each segment is an almost complete individual. Each segment possesses its own nerve fibers and ganglion, its own muscles, its own limbs, frequently its own breathing organs, and, in a partial degree, its own circulation. The intestines of the several segments unite into a common intestine. Indeed this retention of individuality, in some cases, goes still further. There are existing worms which possess eyes in each separate segment. Thus the indications are very marked that the Annelid began life as a colony of budded individuals in which subordination of some of the life functions had taken place. This subordination is yet, in many instances, very slight, the only distinctly specialized segment being the head, with its mouth and sense organs. The loss of individual completeness is not nearly so great as in the members of the Siphonophora.

In its reproductive phenomena the family of segmented worms presents some striking evidences of a colonial origin. In certain instances the worm is born as an individual segment, and gains its mature state by subsequent budding. This is the case with the tape worm, in which the budding process continues indefinitely throughout life. Among the Chætopoda some very significant phenomena are exhibited. A single worm is divided into two through fission between two of the body segments, one of

which becomes the anal region of the anterior worm, and the other develops into the head and several succeeding segments of the posterior worm. The anal region may, by growth and segmentation, give rise to an indefinite number of new segments. In the fresh-water worms, the Nais and Chætogaster, this phenomenon proceeds farther. After the division into two worms and subsequent growth by segmentation, fission again and again takes place, whenever four or five new segments are added in front of an anal zone, so that a chain of zoöids is formed, each with a few segments only and all fed from the mouth of the anterior one. Subsequently they break up into free individuals, each of which lengthens by budding.

This phenomenon strongly indicates an original possession of the full life functions by a single segment which formed, by asexual reproduction, a longitudinal colony. Each member of this colony, while subordinated in function, tends to complete development, as is shown by the fact that certain segments apparently regain lost organs and resume discarded functions. The seeming indications is that these organs and functions were part of their original life plan, and that their ordinary development is only a partial one.

In fact, in all these cases of individuals developed from colonies, the segments or organs present certain analogies to the larval state of other animals. The larva is an instance of retarded development in which the surrounding conditions check for a time the further unfoldment of the life plan, and cause the assumption of new temporary organs or functions. In the segment the unfoldment of the life plan is in like manner checked, and occasionally new organs or functions are developed to bring the organism into harmony with surrounding conditions. Ordinarily the larva enters into new conditions and resumes its checked development. Ordinarily the segment fails to enter into new conditions, and its development continues partial. Yet there are interesting instances in which the larval retardation continues for life, as in the Leptocephali, or embryonic fish.[1] And to complete the analogy we have the above interesting instance of the Chætopoda, in which the developmental energies of the segments appear occasionally to triumph over the retarding conditions, and

[1] See paper on "Growth and Development," AMER. NATURALIST, July, 1883, p. 725.

to cause a nearly complete unfoldment of the original life plan. The main difference between the larva and the Annelid segment, or the Hydrozoan organ, is, that in the former the animal is checked in an embryonic stage, in which it possesses full life functions; in the latter it attains its mature stage, but with only a portion of the life functions. In the former it displays an independent immaturity, in the latter a subordinated maturity. But with these distinctions we seem to behold in all these phenomena the results of one law of nature, a checked development, under the force of circumstances, of forms which have an innate tendency to complete their development, which tendency becomes effective as soon as the retarding conditions are removed, and at times seemingly in spite of them. There appears to be a persistent strife between the active external conditions and the innate hereditary life energies.

The embryological development of the Annelids presents indications like those of the Hydrozoa. They leave the egg as globular masses of untransformed cells. This cell mass elongates and becomes segmented, while the head organs appear anteriorly. The number of segments increases by the interposition of new ones, the segmental organs appear, and the young animal gains the mature form. In this process the indication of an original colonial origin is evident, though perhaps less so than in the Hydrozoa. The asexual budding by which the mature animal is formed is certainly significant, and points to the character of its phylogenetic derivation.

In the Arthropoda appears the highest known development of this principle of the formation of individuals by the transformation of colonies. Of these the Myriopoda alone present clear indications of colonization. In them the segments are as similar to each other as in the Annelida, and like the latter possess nearly all the life organs. Each segment has its own nerve ganglion and fibers, its breathing organs, muscles, intestine and vascular space. It lacks only the mouth and the sense organs of the head-segment to be a complete animal. And its formation by the indefinite budding of new segments is significant of its origin.

In the Crustacea, Insecta and Arachnida, the traces of the original colonial condition are much less evident, though they are ordinarily quite manifest in Crustacean and insect larvæ. And

even in the highest of the Arthropoda, the insects, the original individuality of the segments is not quite lost in the mature state. The primitively individual members of the colony stubbornly resist the cession of their separate functions, and only partially yield to the common needs. This persistent individuality of the segment is partly manifest in their legs and wings, which are appendages of separate segments; but more particularly in the segmental succession of their nervous, muscular and respiratory organs, and in their segmented chitinous armor. Indeed, the Crustaceans and Insects indicate a lateral as well as a longitudinal development of individual segments, for the limbs present significant traces of an origin in the budding process. They appear, in fact, to be a series of specialized segments which have become greatly degraded from their original organic completeness through disuse of the internal organs. Each possesses its muscles, its chitinous armor and what may represent its intestinal cavity. The successive joints of the limbs appear to result from a continuance of the budding process. This seems evidenced by their power of reproduction by budding, when broken off at the joint, and also by the lateral budding which frequently takes place at the extremities of the limbs.

As for the reproduction of the Arthropoda, it tends to disguise their colonial origin, yet only partly so. They are usually born as partially developed colonies, resembling the Annelida in general configuration. But this merely indicates an acceleration of development, or an embryological growth to a considerable extent through the aid of maternally-provided nutriment. In the highest insects, the ants and bees, the parental care is continued until maturity. The growth of the embryo from nutriment provided by the maternal body in no essential sense differs from its continued growth from nutriment provided by the workers, and it is not thrown upon its own resources until maturity. This is the final and highest outcome of the colonial method of animal formation, one in which the members of the colony have become so welded together and subordinated as to have almost vanished from observation, and in which the young begins its individual life in the mature state.[1]

The review we have here given of the method of development of individual animals through a process of colonization, and the

[1] For a somewhat different consideration of this topic see "The Evolution of Organic Form," *Popular Science Monthly*, Nov., 1880.

reduction of the members of the colony to the condition of organs of an individual, may be briefly concluded and perhaps strengthened by a reference to the sub-kingdoms of animals whose members appear to develop as individuals and not through colonization, and whose organs arise from special modification of the tissues of the individual body, and not from subordination of the separate members of a colony. There are three of these sub-kingdoms, the Echinodermata, the Mollusca and the Vertebrata. Of these, indeed, the first is supposed by Haeckel to arise from a colony, since he ascribes the star-fish to the original junction of five worm-like animals. The evidence in favor of this, however, is not convincing, and is not sustained by any distinct evidence of budding in the development of the embryo. In regard to the Mollusca their individual derivation is unquestionable, and their organs present no indication of assuming the typical molluscan form. The segmental character of a part of the body of the Vertebrata has been adduced as an argument in favor of their colonial derivation, but this argument is unsustained by any other evidence. There is no indication of segmentation in the organs, none of which are successively repeated, as in the Arthropoda and Hydrozoa. These organs indeed present every indication of originating in the transformation of the tissues of an individual, and display no evidence whatever of a tendency to assume the parental form. The only indication of colonial aggregation is in the segmental repetition of the vertebrate bones and their accompanying nerve ganglia, but this segmentation may perhaps be better explained in another manner.[1]

In vertebrate embryology there is no clear evidence of segmentation; and the lowest vertebrate, the lancelet, possesses the vertebral characteristics very imperfectly. The Tunicata yield some indication of a connection with the Vertebrata by the segmentation of their posterior body in the embryo state, but this very low stage in the line of vertebrate development is utterly unlike the accordant stage of articulate development. In the latter each segment is furnished with nearly all the organs necessary for individual life. In the former the functional organs develop within the anterior undivided body, and the segmentation is limited to the tissues of the tail, and is perhaps due to the need of flexibility in the swimming motion of a homogeneous organ.

[1] See "Evolution of Organic Form," *Pop. Science Monthly*, Nov., 1880.

As for the reproductive phenomena of the animals here considered, there is no essential distinction from those of the colonial class. In the low forms the young are born immature, in the high forms they are born mature, but in all cases their real birth is as a single cell into the ovary, while the after development is gained partly within the maternal body or the egg, partly in the external world. Yet in this respect the highest vertebrate presents an interesting parallelism with the highest arthropod. As the ants continue to feed the embryo after birth until it has assumed the mature form and is able to obtain its own subsistence in the method of the mature animals, the same may be said of the birds and the Mammalia, which continue to supply their young with food after birth until they are able to provide for their own needs in the parental method. Thus at the summit of the organic series the young begins its individual life as an animal mature in every function except the reproductive.

The colonial origin of the higher plants is equally significant with that of the animals mentioned. As compared with the animal world their closest analogy is with the colonies of the fixed Hydrozoa, in which, from a common stem attached to the surface, outgrow successive nutritive and reproductive individuals. This description applies exactly to the highest plants, with the exception that they are attached to the ground by roots, which are also transformed individuals.

Even the escape of the reproductive members of the Hydrozoan colonies as free Medusæ is not without its analogies in the vegetable world, whose shed spores become reproductive individuals. The fact is that all high development in plants is attained by the method of colonization, and that the advancement in this direction is far inferior to that gained by the higher animal colonies.

The lower sub-kingdoms of plants are not clearly distinct from cell colonies. They are born as single cells, which subsequently develop into cell masses. These, particularly in some of the higher Fungi, become very complexly organized, yet they display little or no cell differentiation, and may properly be considered as cell colonies. The spores, which are shed by all the lower orders of plants, are free asexual offspring probably peculiar only in being specially rich in protoplasm, and thus well adapted to active growth. Such an asexual growth takes place

in the spores of all plants from the Fungi to the Ferns, and sexual propagation arises through a combination of two cells produced by this secondary growth.

As the gastrula seems to be the primitive form of the many-celled animal, so we might reasonably look for some parallel typical form in plants. In all higher plants the leaf is the most apparent fundamental form. Yet the leaf is the result of a considerable degree of evolution, and is preceded in the lowest plants by a mere mass of undifferentiated cells which assumes no typical form. There is no requirement of a digestive cavity to which the fundamental form of animals is due. This cell mass assumes the leaf shape in some of the Algæ. In the mosses the leaf becomes more definitely organized, and still more so in the ferns, but gains its highest condition only in the phanerogams. The embryological development passes through conditions analogous to those of animals. Birth consists in the extrusion of a single cell which, after fertilization, develops into a cell colony, and subsequently, in the higher plants, produces embryo leaves, stem and root in its ovarian development. In all plants a mass of unorganized tissue represents the early cell colony, while the leaf and the flower appear in the higher plants as the ultimate results of vegetable evolution. But these higher plants are in no proper sense individuals. They are colonies of but slightly subordinated members. The mosses, the ferns and their congeners, are little more than leaf colonies. An Endogen is an organic colony each of whose members is a single leaf. In the Exogen the final step of progression is made, and the individual member of the colony is a group of leaves, attached alternately to an unbranched stem.

In all plant colonies a stock-mass or stem is formed, which serves as a reservoir of nutriment and a vascular organ. In the mosses and lower ferns this stem lies under ground, while the germs which it produces unfold into colonies of individual stems or leaves. The colonies are annually reproduced, and each adds something to the dimensions of the stock mass, which, in the higher ferns, emerges from the ground, and gradually extends upwards into the air. This fern stem has no power of self-growth. It is made up of the bases of old leaves, of vascular bundles which serve to supply the new leaves with nutriment, and of aërial roots which grow abundantly from its sides, and add much to its thickness.

In the Endogen the colonial character of the tree is equally or perhaps yet more evident. The stem is, as it were, a fertile soil, in which annual colonies of leaf individuals take root. For the leaf is not properly an organ of the tree, but is an individual which is rooted in the tree, as the tree itself in the soil. The vascular bundles or the root fibers of the leaves force their way far down into the trunk, as if in search of nutriment, and thus add new tissue to the stem throughout its whole length. Neither in the Fern nor the Endogen has the stem any power of self-growth (except in some special instances), there being no germinal tissue except at the extremity of the stem. The tree fern adds new tissue mainly to the extremity of the stem, which increases in diameter only by the outgrowth of adventitious roots. The Endogen, by the downward growth of vascular bundles from the leaves, adds new tissue throughout the stem, which in consequence becomes exceedingly dense and hard, but which has no growth in diameter.

In the Exogen other features of progression appear, and the colonial character has become less evident. The individual member of the Exogen colony is no longer a single leaf, but a group of leaves, seated on an unbranched connecting stem. And the vascular bundles proceeding from these leaves can be traced but a short distance into the substance of the stem. The members of the colony seek less for individual service by aid of their fibrous roots, but trust more to the general vascular service of the stem. This service is more easily performed from the fact that the exogenous trunk retains active tissue throughout its whole length. Thus cell reproduction is constant, and the stem increases annually in diameter. In addition the presence of germinal tissue throughout the stem permits asexual reproduction elsewhere than at the apex, as in Ferns and Endogens, and reproductive buds may be formed at any point in the cambium layer. Thus the Exogen, though a colony in origin, has made a decided movement towards a composite individuality, though it is far from having attained the definite individuality attained by the higher animal colonial groups.

We have, thus far, considered only the leaf members of the plant colony. There are two other members, the root and the flower, both produced by asexual budding, the former representing an earlier stage in vegetable evolution than the leaf, the latter

the most highly evolved members of the plant colony. The plant stem which connects these individuals resembles the stem of the Cœlenterate colony in its vascular function. But the plant colony has the peculiar feature that it includes two distinct forms of nutritive individuals, each absorbing a special kind of nutriment. The water and the nitrogenous elements of the food are absorbed by the roots, the carbonaceous by the leaves. Just where the chemical combination of these various elements into protoplasm takes place, whether in the leaves or the stem, is not known.

It appears, from these considerations, that the tree is not a colony in a simple sense, as in the Polyzoa, in which precisely similar individuals are aggregated; but in a complex sense, as in the Hydrozoa, in which each individual performs but a part of the life functions, and is dependent upon other individuals for the remainder. Thus the tree is, in one sense, an individual, with three kinds of organs, but in a truer sense, a colony of partly subordinated individuals.

The third form of organ, or member of the colony, the reproductive, is in its origin a modified leaf group. It has no nutritive powers, its sole duty being sexual reproduction. This reproductive function we need to consider in conclusion. The plant colony, like the animal colony, is built up by asexual budding. These buds, in the higher plants, attain a considerable degree of development ere their individual life begins. They enter upon their life duties neither as simple cells nor as simple leaf organs but as leaf colonies. Thus the product of a Phanerogamous bud is not a single leaf, but a group of leaves, each of which, however, retains its individuality in the Endogens, but loses it in great measure in the Exogens, in which the twig with its leaves acts as a compound individual. This is another instance of "Acceleration of Development," an advanced degree of development being attained under the parental care, ere the offspring is thrown upon its own resources as an active individual.

In regard to the sexual individuals a still more declared acceleration is evident. In this respect the history of plants runs parallel with that of animals. In the lowest forms the product of sexual "conjugation" is a single cell, which is at once thrown upon its own resources for development. In somewhat higher forms, as in the higher Fungi, asexual germs, perhaps rich in protoplasm, are shed as free individuals, and grow into the fil-

ments of the mycelium ere sexual reproduction takes place. There seems here a preliminary gathering of nutriment for the use of the sexual germ. In the Ferns this process is repeated in a fuller degree. The asexual spore develops into a *proembryo*, or mass of cell tissue, within which arise the ova and spermatozoa of sexual reproduction. Thus the new-born sexual germ is provided with a stock of nutriment to aid in its embryo development, and the proembryo is in this sense the primitive form of the seed of the higher plants. It, indeed, in a fuller sense, represents the flower of the higher plants, since it acts as a reproductive organ, and produces fertilized germs.

But in the Phanerogams the development of the embryo under the parental care proceeds considerably farther than in the Cryptogams. The young is not shed as a germinal cell, nor as a mass of unorganized cell tissue, nor even as a leaf colony as in the asexual bud, but as a mature plant, with stem, leaf and root all clearly indicated, and surrounded by a store of nutriment to aid in the early stages of its subsequent growth. Thus the seed of the plant is directly parallel to the egg of the animal, and acceleration of development has attained to as high a stage in the one case as in the other. In the highest phases of both plant and animal life the young begins its individual life as a copy of the mature form. In the seed of the Endogen the simple nature of its individual is apparent in the presence of a single seed-leaf, while the double, or the yet more numerous cotyledons of the Exogens, point to the composite character of the exogenous individual.

This paper has grown to too great a length, and yet the subject is but briefly treated. A fuller consideration could have included many other facts in aid of the doctrine of the colonial origin of the organisms reviewed, and also have made more apparent the fact that the organs of individually-developing classes of animals, as the mollusks and the vertebrates, present no indication of a tendency to assume the typical form of the animal, as required by the opposite theory. It is offered but as a partial contribution to the subject, with little value beyond its extension of the inquiry to the whole field of animal and vegetable life, and possibly its effort to place the phenomena of reproduction, and the essential distinctions between the Protozoa and the Metazoa, in a somewhat clearer light.

ANATOMY AND PHYSIOLOGY OF THE FAMILY NEPIDÆ.[1]

BY WILLIAM A. LOCY.

THE value arising from a study of the organs and their functions in any animal, is not limited to a knowledge of the form studied nor to the facts obtained. The general principles of comparative anatomy and physiology will be thus developed, since they exist in the study of the bodies of all animals, and furthermore, the study of a typical form will furnish a key to a more special knowledge of a whole group, just as a type language affords a key to a group of languages. In studying the anatomy and physiology of the family Nepidæ, then, results are obtained which reach far beyond the boundaries of the family and which constitute simply special cases to illustrate the principles of comparative anatomy and physiology.

The functions performed by the organs of animals' bodies naturally fall into three groups, nutrition, reproduction and relation which will form special divisions of this subject to be treated after considering a few generalities.

Methods of work, etc.—The more general methods are briefly considered here, the special methods, when requiring mention, are spoken of in connection with the work for which they are designed.

To dissect successfully the Insecta, it is necessary to work under water or some other transparent liquid, therefore a dissecting slab and a tray are essential. The former is easily made by loading cork or soft wood until it will sink under water; it is better to paint this black to furnish a good background, since the tissues of insects are usually white. Any vessel of convenient size will serve as a tray.

In opening the specimen, which may be done along the median line or at the side, care should be taken to cut simply the integument, which, before cutting, should be raised with the forceps and carefully freed from all attachments. The insect is then to be pinned out upon the slab and dissected under water or alcohol.

The working outfit necessary is neither costly nor extensive, the apparatus just described and the following will be found adequate for all ordinary work: (1) A pair of fine scissors with

[1] Thesis to obtain the Degree of Master of Science, submitted to the University of Michigan.

curved points; (2) a fine scalpel for general cutting; (3) needles mounted in wooden handles are very convenient for separating the tissues and removing small portions piecemeal, these ground to an edge and sharpened form very fine cutting instruments; (4) fine pliers or forceps; (5) a good pocket lens, or better, a dissecting microscope. For all histological work and fine anatomy, a good compound microscope which, however, need not cost more than $35 or $50, is necessary.

Habits, etc.—The family Nepidæ, of the Hemiptera, is represented in our waters by four distinct genera, Belostoma, Perthostoma, Nepa and Ranatra. They are of common occurrence in the ponds and streams about Ann Arbor, except Nepa, which is rarely found. The first three mentioned are flattened and oval in outline, while Ranatra is remarkable for its long linear form.

Belostoma and Perthostoma, the most active forms, have their hind legs admirably fitted for swimming. Ranatra and Nepa, to correspond with their habits, have their hind legs fitted for crawling along the bottom and upon aquatic plants. The fore legs of all the genera are raptorial and armed with a terminal claw. In Ranatra this fits into a groove in the tibia, as the blade of a knife fits into the handle. In the other genera the femur is grooved to receive the fore leg, and the trochanter, the terminal claw. The prey is seized by these raptorial legs and conveyed to the mouth; it is here punctured by the three-jointed beak and the nutriment sucked out. Their food consists of the juices of larval insects, tadpoles, young fish, gasteropods, etc. In Ranatra and Nepa the antennæ are three-jointed, in Belostoma and Perthostoma four-jointed, and concealed in a vaulted cavity opening below the eyes.

The adult Belostomæ are very large, ranging from three to four and a half inches in length, and are the brigands of the streams they inhabit. From their rapacious habits they soon exhaust the food from one locality, then fly to another during the night. They attack aquatic forms several times their own size. In an aquarium I remember having once seen a large Belostoma kill a frog four times its size, despite the fierce struggles of the frog to escape.

In general appearance Ranatra resemble the "walking-sticks." The body ends posteriorly in two long setæ, the grooved faces of which, applied together, form a respiratory tube as long as the abdomen. The front legs are very long, and extend straight out

in front of the body, which throws the center of gravity too far forward for convenient flight.

When preparing for flight the air sacs are first inflated, the prothorax and head are thrown downward, and the front legs disposed of in a very ingenious manner. The femurs are bent upon the joint near the head, a little more than 90° from their original position, and the tibiæ are folded closely against these, thus the front legs hang under the body, directed a little backward.

Though of much smaller size, Perthostoma strongly resembles Belostoma in general appearance, but is quite distinct in antennæ beak and legs. The females of the genus carry their eggs on the back, regularly arranged in a single layer, cemented to the body by a substance insoluble in water. The eggs of the other genera are attached to the water plants and submerged objects.

Belostoma, Perthostoma and Ranatra are infested by a Hydrachna, which is found attached to different parts of the body. This is probably also true of Nepa, but I have not had the specimens to determine. For a fuller account of the external anatomy and the family characteristics, the reader is referred to the works on systematic entomology, while attention is now called to the *internal anatomy.*

A. The Function of Nutrition.

The function of nutrition includes all the processes concerned in preserving the organism of an animal, as the digestion of food, its conveyance to a point for use, the chemical changes of converting food into tissue, and the removal of waste matter. These processes are carried on by the organs of digestion, of circulation, of respiration and of excretion, which form separate subheads for consideration.

I. The Digestive System.

On opening the insect the most prominent set of organs is the alimentary canal and its appendages. The thread-like œsophagus, characteristic of suctorial insects, extends straight from the beak to the metathorax, where it enlarges abruptly into the stomach. The anterior end of the œsophagus is connected with a peculiar pumping apparatus, which will be described later. The division of the digestive apparatus into a distinct crop, chylific ventricle, etc., frequently found among insects, is practically obliterated in these insects; this, indeed, is the case in most of the Hemiptera. Sometimes in Ranatra an oval enlargement exists at the begin-

ning of the stomach (Fig. 3) and another at the end not so well marked, but in neither case are they distinctly separate from the rest of the stomach.

The stomach, taken as a whole, is of unusual size, and much saculated by contraction. In the third abdominal segment its pyloric end opens into the intestine. Both stomach and intestine consist of at least two coats, an external muscular coat and an internal mucous coat. The existence of a third coat in the Hemiptera is a disputed point; though Dr. Leidy mentions it in Belostoma, and I have found it, to the best of my belief, in Ranatra.

The muscular coat consists of both longitudinal and annular fibers, the former predominating. The peristaltic contractions of the alimentary canal are due to these muscular layers, and in the insects under consideration these movements are very energetic and thorough, separating the liquid food into chyle and excrementa. The mucous layer extends the entire length of the alimentary canal, and is most easily observed at the pharynx and at the anus.

Before emptying into the cæcum, the intestine is divided into an anterior and posterior portion by a bulbous enlargement, upon which the Malpighian tubules are situated. The first part may be conveniently called the duodenum, as some authors call it, and the after part the ilium. The duodenum is convoluted upon itself several times. In Belostoma it turns from its origin, first to the left, then upward, running along the left side of the stomach to about one-third its length, then turning upon itself, returns to the median line of the body; from this point it passes upward on the right side of the stomach, turns with an irregular loop and reaches again the median line, where it enlarges into the bulb. The tissues of the duodenum are the same as those of the stomach.

The ilium is slightly larger than the duodenum and coils upon itself five or six times in a sigmoid manner. In the greater number of specimens dissected, the coils were six in number. The ilium empties into a cylinder larger than itself, which represents the colon or rectum. The upper portion, which is separated from the lower by a slight constriction, is sometimes considered as representing the colon, and the lower portion the rectum. This latter diminishes rapidly, and ends in a pointed opening at the anal aperture, which is situated above and behind the genital orifice.

From the colon a large cæcal pouch extends forward, beneath the intestine, reaching in its ordinary condition to the middle of the fourth ventral segment. This is the cæcum. It is sometimes so distended with air as to reach even to the thorax, and to give a bloated appearance to the usually flattened ventral surface of the insect. This organ probably plays the same part as the air bladder of some fishes, serving as a natatory vesicle. I have often seen these insects come to the surface and forcibly expel the air from the cæcum. When the abdomen is just below the surface, the water is thrown upward in jets by the discharged air. I have also noticed the larvæ of Belostoma, when irritated, throw from the anus jet after jet of a strong smelling, light-greenish fluid, the propulsive force of which probably comes from the cæcum.

Frequently when the insects have died in water, the cæcum, naturally white, is found swelled and of a dark-blue or livid color. From the large number of cases in which this has been observed, I think that it is due to some disease. The chief differences in the alimentary canal of Belostoma and Ranatra may be seen by comparing Figs. 3 and 5.

Method of taking Food.—In order to understand how these insects take their food, we must first study the food-taking organ, or the beak. This is a three-jointed tubular structure formed from the modified mouth parts. All masticatory characters are obliterated, the labium is elongated and folded upon itself, forming a sort of trough, which is nearly closed at the top; within this the maxillæ and mandibles are found modified into four bristles which, before entering the trough, pass through a sheath made from the labrum. This sheath projects into the beak, or trough, from above (Fig. 2).

By the action of these bristles the prey is punctured and the food-juices brought to the real sucking organ, the "pharynx." This is a stiff chitinous trough, roofed by a plate of chitine, into which the œsophagus enters from behind. The sides of this trough extend much above the roofing, as shown in a cross section of the apparatus (Fig. 7); from the elevated middle of the roof chitinous threads originate, to which muscles are attached. These extend upward, first in one sheet, then divide into two parts, one going to the left the other to the right, and are attached to the integument of the head. There is no other appa-

rent sucking apparatus in the body, and the only use I can assign to the structure just described, is that of a *pumping organ.* It is probable that the liquid food is sucked into the pharynx by the contraction of the muscles which are attached to the chitinous threads; this process enlarges the pharynx cavity by lifting the roof. From the pharynx the food passes, by muscular contraction, down the œsophagus. [Plates to follow with succeeding number.]

(To be continued.)

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THE CREODONTA.

BY E. D. COPE.

PRESENT knowledge justifies the generalization that, since the Eocene period, the mammalian fauna of the Northern hemisphere has diminished in the number of its species and genera. The Eocene fauna was richer than the Miocene; the Miocene than the Pliocene, and the Pliocene was richer than the modern fauna. With this numerical diminution in species has come increased specialization of structure, which means both greater perfection of mechanism and greater diversity of type.[1]

The order of Carnivora is a universal and well-known factor of the mammalian life of the present period. It was equally so in the Pliocene and Miocene periods. When we come to examine the overflowing life of undoubted Eocene time, we can no longer find mammals which possess the essential characters of the order. The Carnivora are unguiculate gyrencephalous mammalia with a coössified scaphoid and lunar bone of the carpus, called, therefore, the scapholunar bone. They have a grooved astragalus. No scapholunar bone has yet been found in any Eocene mammal in North America, and it is doubtful whether any has been found in Europe. Nevertheless the Eocene fauna did not lack predatory flesh-eaters whose function was like that of the Carnivora of later periods, to restrain the undue increase of all other forms of life. Their variety was greater than that presented by their carnivorous successors on the North American continent, and their numbers were proportioned to the general luxuriance of the life which furnished them subsistence. There were species whose size and powers of destruction equaled those of the bears, lions and tigers of modern times. Species of medium size abounded,

[1] This generalization was published in the Report U. S. G. G. Survey W. of 100th meridian, 1877, IV, p. 385.

while the smaller forms, representing in function the civets and weasels of to-day, were especially numerous.

The systematic position of these animals has been difficult to determine with satisfactory precision, owing to the imperfect knowledge which we possess of their structure. Besides lack of scapholunar bone, they nearly all differ from the Carnivora in their ungrooved astragalus, and their greatly reduced and smooth cerebral hemispheres. Their position then can only be with the Marsupialia or the Insectivora. The superficial resemblances are often to the former order, where the carnivorous types Thylacinus, Sarcophilus, Dasyurus and the opossums, seem to present near affinities, if the structure of the teeth only is to be considered. Laurillard, DeBlainville and Gaudry have, at different times, assigned to them this position. It is true, however, that no one osseous character, except the possession of marsupial bones, has yet been discovered which characterizes the order Marsupialia. It rests chiefly on the characters of its soft parts, especially of the brain and reproductive system. Most marsupials have the angle of the lower jaw inflected; the Eocene flesh-eaters do not. The carnivorous marsupials generally have more than six incisor teeth; the Eocene flesh-eaters have six or less. The marsupials generally have perforated palates; the Eocene forms never display the character. No marsupial bones have yet been found in the Eocene forms (with the possible exception of Mioclænus), so that we cannot yet find the necessary reasons for placing our extinct forms with the order which possesses them. On the other hand the brain was probably marsupial in its internal character as it certainly was in its external character. Finally, the discovery of the character of the temporary dentition in the Eocene flesh-eaters has added force to the view that they cannot be marsupials. M. Filhol has shown that in Hyænodon there were three temporary molars, and I have proven that there were at least two in Triïsodon. There is, according to Flower, but one in the Marsupialia. It is, however, to be remembered that true marsupials, opossums, occur in the Oligocene in both North America and Europe (genus Peratherium Aym.), and that they resemble their Eocene predecessors very much, especially in the constitution and form of the molar teeth.

The comparison with the Insectivora betrays no such fundamental diversities as that with the Marsupialia. The differences

are of minor import, although in particular cases considerable. In spite of their often large size and evidently predatory habits, the Eocene flesh-eaters must be placed with the Insectivora. But as I have already pointed out,[1] they have contemporaries which must go with them. These are two groups, the one with rodent, the other with edentate tendencies, the Tillodonta and Tæniodonta. The former of these is intimately allied to the living Chiromys of Madagascar, which itself is almost a lemur, by gen-

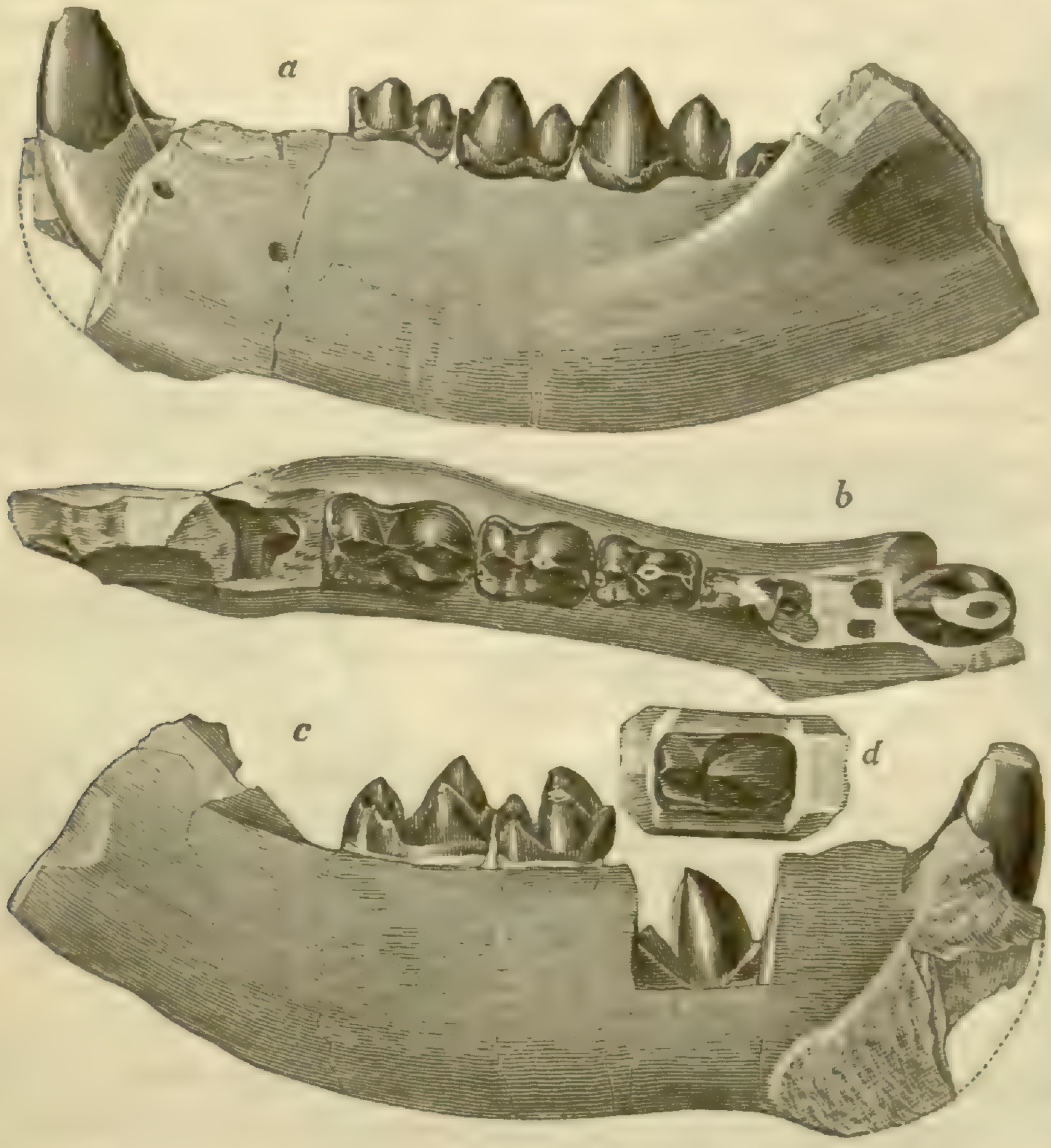


FIG. 1.—Left mandibular ramus of *Triisodon quivirensis* Cope, three-fourths nat. size, from the Puerco beds of New Mexico. Fig. *a*, external view, displaying the last temporary molar in place; *b*, the same from above; *c*, the same, internal side, the temporary molar removed and the permanent fourth true molar displayed in the jaw; *d*, the fourth permanent premolar viewed from above. Original; from Vol. IV, Report U. S. Geological Survey Terrs., F. V. Hayden in charge.

eral consent. The whole of this assemblage I have regarded as an order of mammals to which I have given the name of the Bunotheria. In this order there are included six suborders, and

[1] Report U. S. G. G. Surveys W. of 100th meridian, G. M. Wheeler in charge, IV, p. 85, 1877. Proceedings Academy Philadelphia, 1883, p. 77.

the carnivorous type of this series, the group now under discussion, I have called the Creodonta.[1] Its definition is as follows:

Neither incisor nor canine teeth growing from persistent pulps. Hallux not opposable. Superior true molars tritubercular or more simple.

The only character which distinguishes the suborder from the Insectivora is the possession of tritubercular or more simple molars above. This is, as I have shown,[2] a feature of more importance than has been hitherto supposed. The tritubercular molar is the primitive type from which the quadritubercular has been directly derived. It has furnished the starting point for both the carnivorous and the herbivorous dentitions, since it was common to both the clawed and hoofed mammals of the Puerco or lowest known epoch of the Eocene period.

So far as known, the Creodonta were all plantigrade, and had long tails, and were mostly five-toed. With the possible exception of *Protopsalis tigrinus*, they all had relatively larger heads and shorter legs than the majority of the Carnivora of the present period. This is true of all the recent Creodonta, none of which reach the dimensions of many of the fossil forms.

The contents of the suborder Creodonta display, in their modifications, the usual range of simplicity and complexity consistent with the type, and the families may be arranged in some sort of phylogenetic order, in accordance with this principle. Nevertheless a difficulty arises as to what are ancestral or primitive conditions, and what characters, if any, must be regarded as the result of degradation. As other parts of the skeleton are less frequently obtained, these considerations relate chiefly to the dentition.

In my paper on the Homologies and Origin of the types of Molar Teeth, etc.,[3] I pointed out that the cone was the simplest form of tooth from which all others must have been derived. In the Mammalia this may have been modified in several ways simultaneously, but two methods present themselves as the most certain secondary primitive types. The first of these is that of the simple premolar, where the cone is compressed, and is sooner or later followed by a horizontal extension or heel. This type persists

[1] For greater detail on this topic, see Proceedings Philadelphia Academy, 1884, p. 77.

[2] Proceedings American Philosophical Society, 1883, p. 324. Palæontological Bulletin, No. 37.

[3] Journal Academy Nat. Sciences Philada., 1874, March.

the inferior true molars of the Mesonychidæ. The second modification consists in the addition of lateral cusps or spines to the simple cone. Such a type is seen in inferior molars of *Spalacotherium tricuspidens* Ow., of the Jurassic period, and in some of the incisors of *Plesiadapis tricuspidens*[1] Gerv. This form, by the shifting of the two subordinate cusps to the inner side of the principal one, will give a trituberculate molar of the lower series, an exaggeration of which is seen in the South African "mole,"

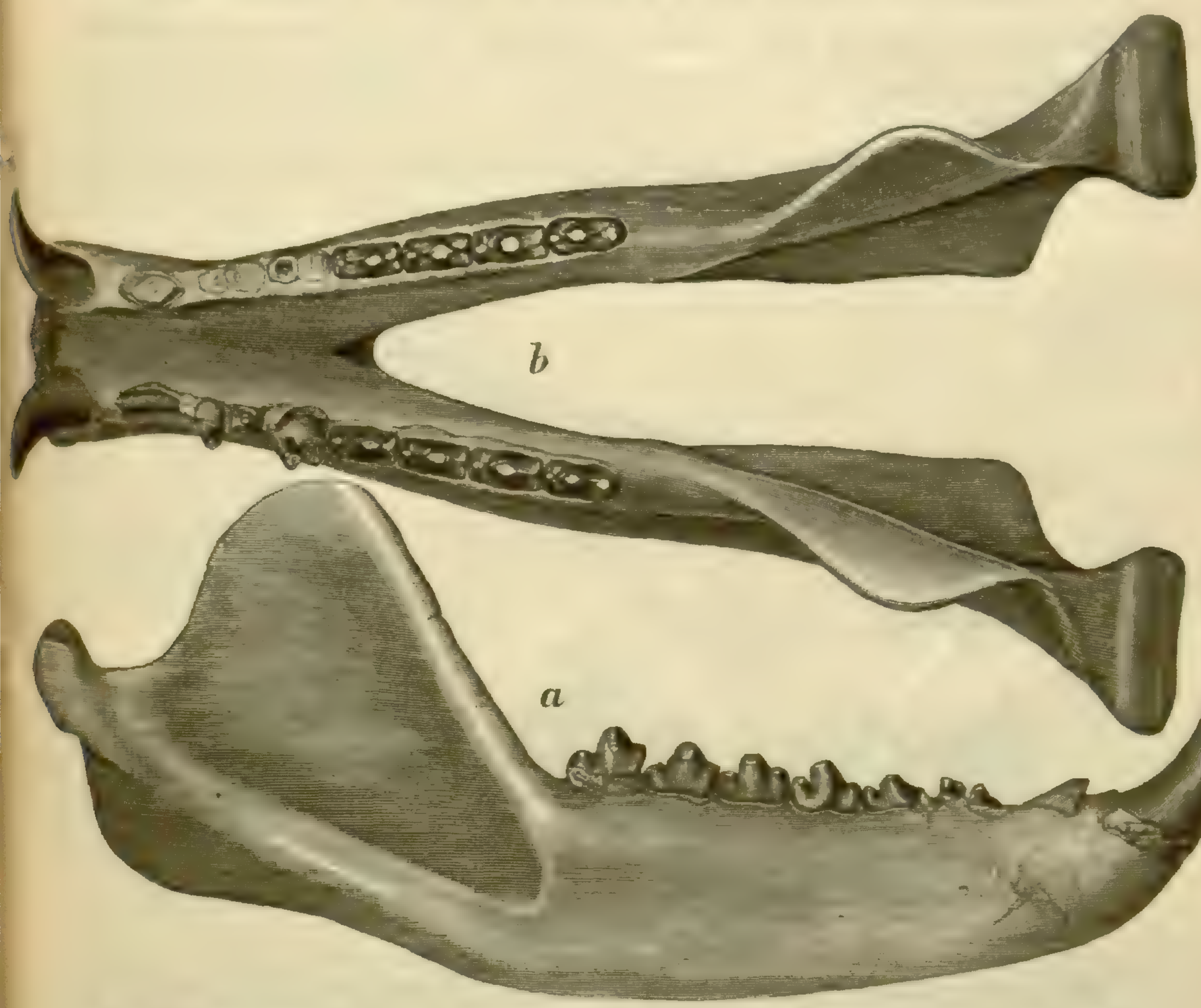


FIG 2.—Mandible of *Mesonyx ossifragus* Cope, from the Wasatch epoch of the Big Horn river, Wyoming, one-third nat. size. Original. From Report U. S. G. S. Terrs., Vol. III.

Chrysochloris. If a cingulum appears at the posterior base of such a tooth, we have a rudimental "heel," such as is seen in Centetes, and is still better developed in many creodont and marsupial genera, forming the basis of the inferior sectorial tooth of the Carnivora. This, which I have called the "tubercular-secto-

[1] Lemoine. Communication sur les Ossemens Fossiles d.' env. Reims, p. 9, pl. II, fig. 13. The superior dentition of this specimen is represented in fig. 6.

rial," is especially well marked in Oxyæna (Fig. 3) and Stypolophus.

All stages of diminution of the anterior of the two inner cusps of the inferior molars may be seen in the genera of Centetidæ, as for instance in Ictops and Diacodon, until a true quadritubercular molar is reached as in Mioclænus. In Miacis and Didymictis one tubercular-sectorial remains with one or more tubercular. The process of developing a tubercular inferior molar from a tritubercular tooth, is the reverse of what has taken place in the Carnivora, where the tubercular-sectorial has, by loss of parts,

FIG. 3.—*Oxyæna forcipata* Cope, mandible from the Wasatch bed of New Mexico, one-half natural size. Original from Report U. S. G. G. Survey W. of 100th mer. G. M. Wheeler, Vol. IV. The numbers indicate the approximate premolars and true molars.

become a true sectorial. With these explanatory remarks I present the following definition of the families. I have formerly used the shape of the astragalus as a family definition. In the majority of the Creodonta its trochlear face is not grooved. In the Mesonychidæ it is strongly grooved. In Mioclænus and some species of Stypolophus, as well as in the moles, it is slightly grooved:

I. Inferior molars premolariform.

Inferior molars consisting of a cone and heel.....*Mesonychidæ*

Inferior molars with a blade formed of anterior and median cusps...*Hyænodontidæ*

II. Inferior molars tritubercular without heel.

No sectorial teeth; tibia and fibula coössified..... *Chrysochloridide.*

III. Inferior molars tritubercular-sectorial or quadritubercular.

a. No superior sectorial teeth.

Tibia and fibula distinct..... *Centetidæ.*

Tibia and fibula coössified; external tubercles of superior molars sub-conic, no clavicles.....*Mythomyidæ.*[1]

Tibia and fibula coössified; external tubercles two Vs; clavicles.....*Talpidæ.*

aa. First true superior molar sectorial.

Tibia and fibula distinct; no tubercular molars.....*Oxyænidæ.*

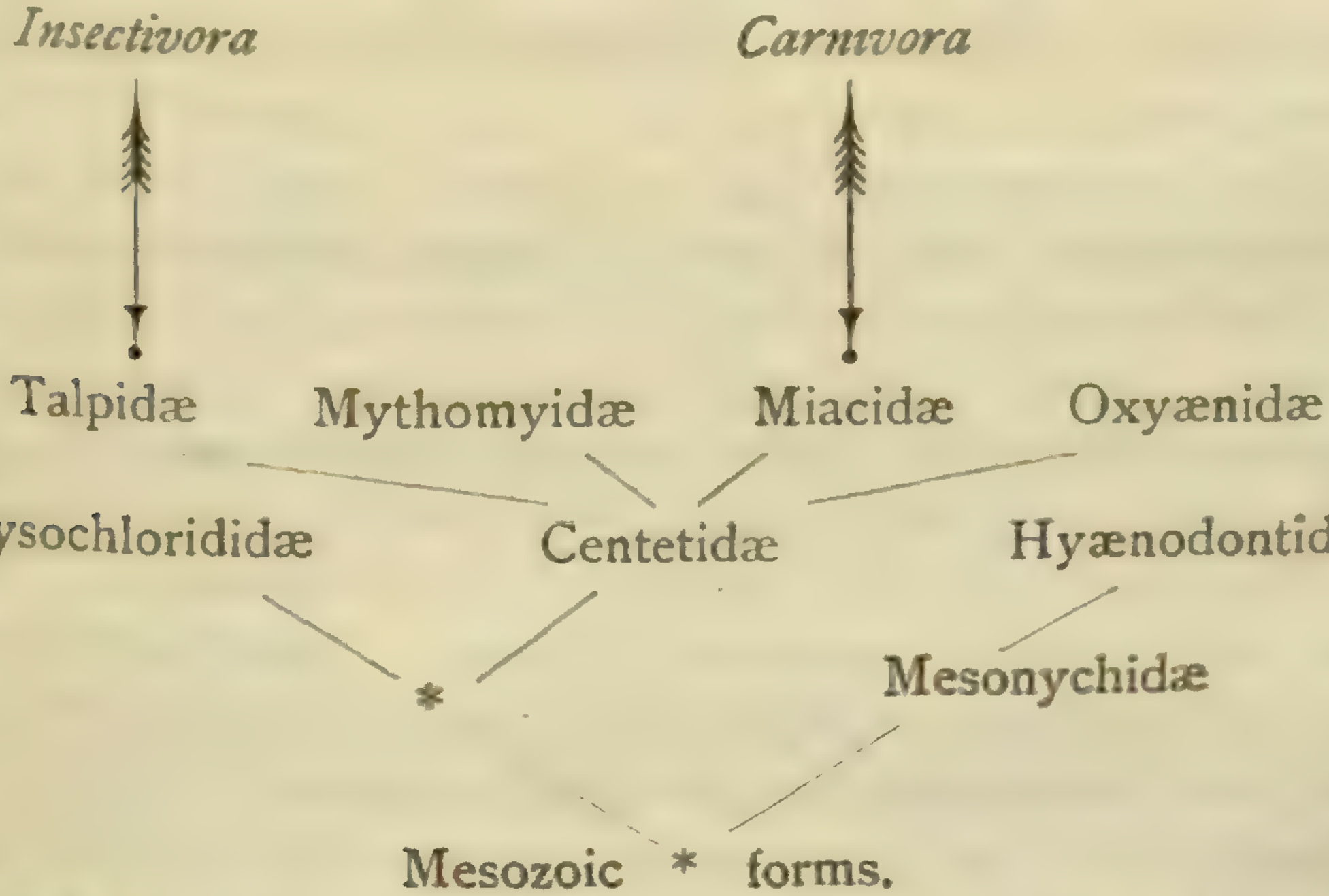
aaa. Fourth superior premolar sectorial.

Tibia and fibula distinct; true molars tubercular.....*Miacidæ.*

The number of genera and species embraced by these families is as follows. The extinct forms only are enumerated, and those of North America are specified:

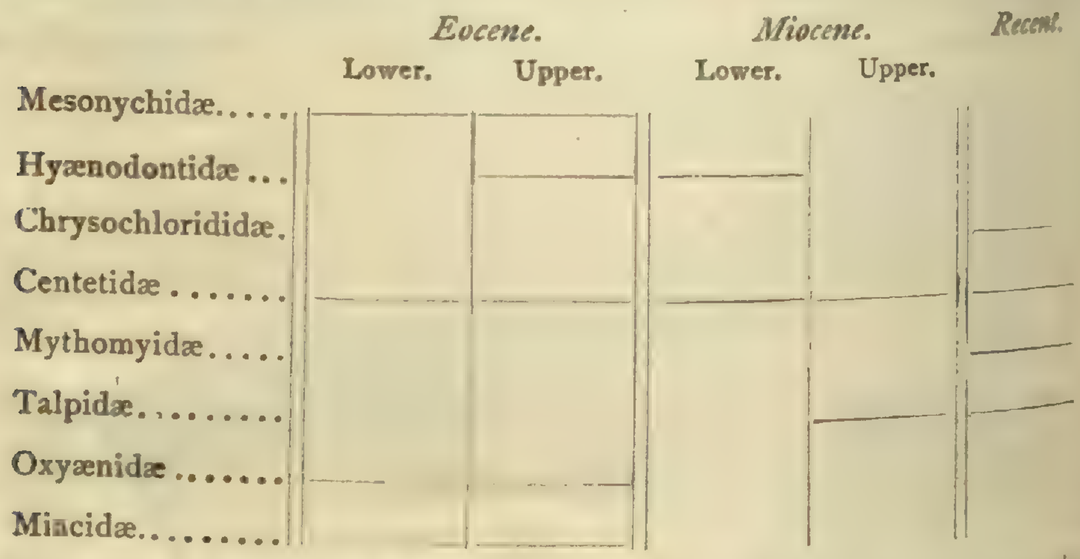
Families.	*Genera.*	*Species.*	*N. America.*
Mesonychidæ	4	7	7
Hyænodontidæ	1	10	3
Chrysochloridide	*	*	
Centetidæ	18	44	37
Mythomyidæ	*	*	
Talpidæ	*	*	
Oxyænidæ	3	7	4
Miacidæ	2	12	12
Totals	28	80	63

The affinities of these families may be expressed in the following diagram, which may be regarded as an attempted phylogeny also:



[1] This family is sometimes called the *Potamogalidæ*. Mythomys is, however, the name first published, with a description, for the typical and only genus.

In geological time the Mesonychidæ, Miacidæ and Oxyænidæ are confined to the Eocene period. The Hyænodontidæ extend through the Upper Eocene and Oligocene or Lowest Miocene formations. The Centetidæ are predominately Eocene, but in North America they are also found in the Oligocene. In recent times they are only known in the islands of Madagascar and Cuba. The Chrysochloridídæ are modern and African, while the Talpidæ commence in the Middle Miocene in Europe, and are as abundant in recent times in the Northern hemisphere. Mythomyidæ are only known as recent in Africa. These relations may be expressed as follows:



The distribution of the genera with relation to the American formations will be considered later.

Mesonychidæ.

In this family the form of the inferior molars is not very different from that displayed by the last lower premolars of carnivorous Mammalia generally. The superior molars are of correspondingly simple structure, in like manner resembling the last premolars of the superior series of Carnivora and some other Mammalia. There are two types in the family. In the first, the astragalus is flat, as in most Creodonta (Fig. 5 *a b*). The only known genus is Amblyctonus, which I have, on account of its astragalus, placed in a separate family, the Amblyctonidæ. This course may be justified by future discovery. The inferior molars also differ from those of Mesonyx in the development of the anterior cusp, thus approaching the Hyænodontidæ (Fig. 4). The bones of *Amblyctonus sinosus* Cope, are about as robust as those of the coyote. They have so far been found only in the Wasatch beds of New Mexico. M. Fischer has described an allied mam-

mal from France under the name *Apterodon gaudryi*. He has not stated how this genus differs from Amblyctonus.

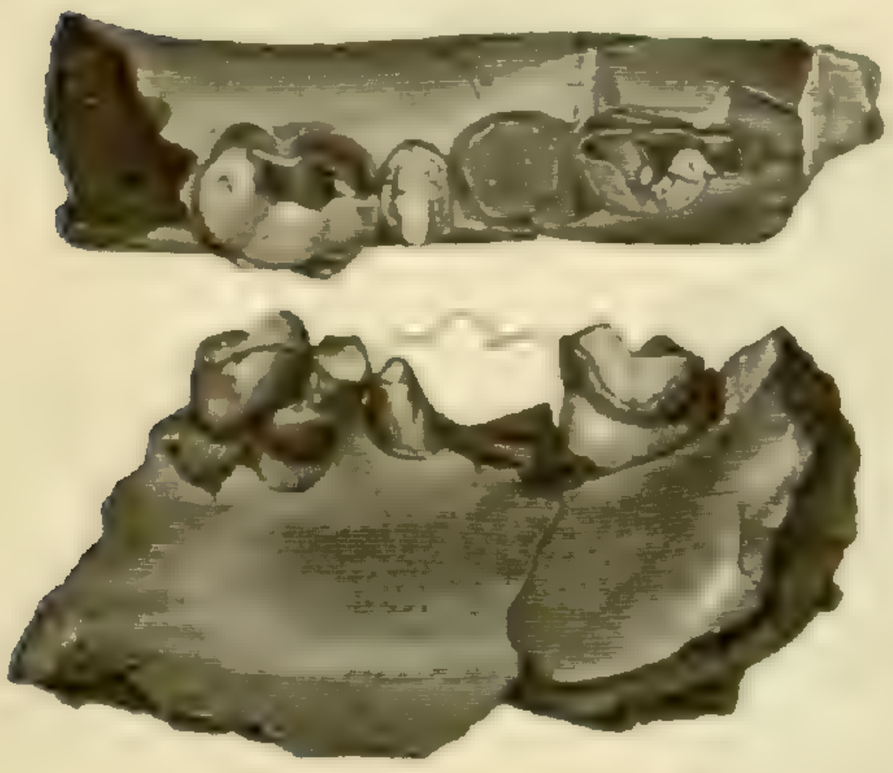


Fig. 4.

Fig. 5.

FIG. 4.—Part of mandibular ramus of *Amblyctonus sinosus* Cope, with the last three molars; upper figure the same, from above; two-thirds nat. size. From the Wasatch beds of New Mexico. FIG. 5.—Distal ends of tibia of, *a–b*, *Amblyctonus sinosus*, and *c d e*, *Oxyæna morsitans* Cope; *b* and *d*, distal views; two-thirds natural size. From the Wasatch beds of New Mexico. Original, from U. S. G. G. Expl. Surv. W. of 100th mer., G. M. Wheeler.

In the genus Mesonyx we have a structure of the astragalus found only elsewhere in flesh-eating mammals in the Hyænodon.[1] Its distal extremity has two well-marked facets, one for the navicular bone and one for the cuboid (Fig. 9). The appearance is that of a perissodactyle mammal, and the astragalus of the Mesonyx might well be taken for that of an ungulate of that suborder. The tibial face of the bone is grooved, another point in which it differs from most of the Creodonta. Still another characteristic peculiarity is seen in the forms of the ungues. These are neither claws nor hoofs, but between the two, resembling the corresponding part in some Rodentia. Their deeply fissured extremities show that they are rather allied to claws than to hoofs (Fig. 10). The narrow navicular facet of the astragalus renders it probable that the inner digit or hallux is wanting, and that there are but four toes in the hinder foot. The form of the trapezium shows that there are but four toes on the anterior foot (Fig. 7). One more character completes the singular ensemble presented by this genus. The zygapophyses of the lumbar vertebræ embrace each other as in the lower perissodactyles and artiodactyles, a character not found in the Carnivora or Insectivora.

[1] Fide Professor W. B. Scott.

Among the Creodonta I have only observed it elsewhere in the genus Mioclænus,[1] but the vertebræ of many of these animals are unknown. It is wanting in Thylacinus and the opossum, and rudimental in Sarcophilus, among marsupials.

Three species of the genus Mesonyx are known, *M. ossifragus*

FIG. 6.—*Mesonyx ossifragus* Cope, skull anterior to postglenoid processes, inclusive, from below; one-third natural size. From the Wasatch beds of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., III, F. V. Hayden.

Cope, from the Wasatch Eocene, and *M. lanius* and *M. obtusidens* Cope, from the Bridger. The last named is the type. It is about the size of the wolf, and had more slender feet and claws than

[1] Proceedings American Philos. Society, 1883, p. 543.

the other two. The *M. lanius* was considerably larger than the *M. obtusidens*, equaling the black bear (*Ursus americanus*) in size. It had a large head, with a long, rather narrow and truncate muzzle. The limbs were relatively smaller, not exceeding those of the black bear in length and thickness. The tail was long and slender as in the cats, while the claws were broad and flat as in the beaver.

The molar, canine and incisor teeth of my specimen, as well as those of one in the Princeton Museum, are much worn by use. This is especially true of the canines of both, while the crowns of the molars of my Bitter Creek specimen are almost entirely worn away. The same peculiarity is to be observed in the specimens of the allied *Amblyctonus sinosus*, which I obtained in New Mexico. It is probable that these species chewed hard substances. The peculiar approach of the lower canines is a special modification for peculiar habits, which I suspect to have been the devouring of the turtles which so abounded on land and in the waters of the same period. The slender symphysis could most readily be introduced into the shell, while the lateral pressure of the upper canines with the lower, would be well adapted for breaking the bony covering of those reptiles. The breaking of these shells in the attempt to masticate their contents would produce the unusual wear of the teeth observed.

FIG. 7.—*Mesonyx lanius*, left anterior foot, one-half natural size. Upper figure first row of carpal bones of right side of same individual, proximal view. Original. From the Bridger beds of Wyoming.

The *Mesonyx ossifragus* is the largest species, its skull exceeding that of the grizzly bear in dimensions (Figs. 2, 6, 8, 9 and 10). It was originally found by the writer in the Wasatch beds of New Mexico, and was afterwards found by Mr. Wortman to be not uncommon in the corresponding formation in Northern Wyoming. From material obtained by this gentleman, we can form a general idea of the form and proportions of the *Mesonyx ossifragus*. We can depict an animal as large as a large-sized American black bear, with a long, stout tail and a wide head as large as that of a grizzly bear. The fore limbs are so much shorter than the hind limbs

that the animal customarily sat on its haunches when on land. In walking, its high rump and low withers would give it somewhat the figure of a huge rabbit. Its neck was about as long as that of an average dog. Its tread was plantigrade, and its claws like those of various rodents, intermediate between hoofs and claws. The animal, to judge from its otter-like humerus, was a good swimmer, although there is nothing specially adapted for aquatic

Fig. 8. Fig. 9.

FIG. 8.—Anterior limb bones of the specimen of *Mesonyx ossifragus* represented in Figs. 2 and 6, one-third natural size. Fig. *a*, humerus from front; *b*, distal view of distal extremity; *c*, right ulna and radius, external view; *d*, the same from above. FIG. 9.—Posterior limb of *Mesonyx ossifragus*, the individual represented in Figs. 2, 6 and 8, one-third nat. size. Fig. *a*, femur from front; *b*, tibia from front; *c*, tragalus and calcaneum from above; *d*, the same, distal view. From the Big Horn region of the Wasatch epoch.

life in the other bones of its limbs. Its teeth, on the other hand, are of the simple construction of the mammals which have a diet largely composed of fishes. We cannot but consider this animal

as one of the most singular which the Eocene period possessed. In size it was not exceeded by any other flesh-eater of the period, but was equaled by the *Protopsalis tigrinus*. Its anterior limbs were evidently relatively shorter than in the *Mesonyx lanius*.

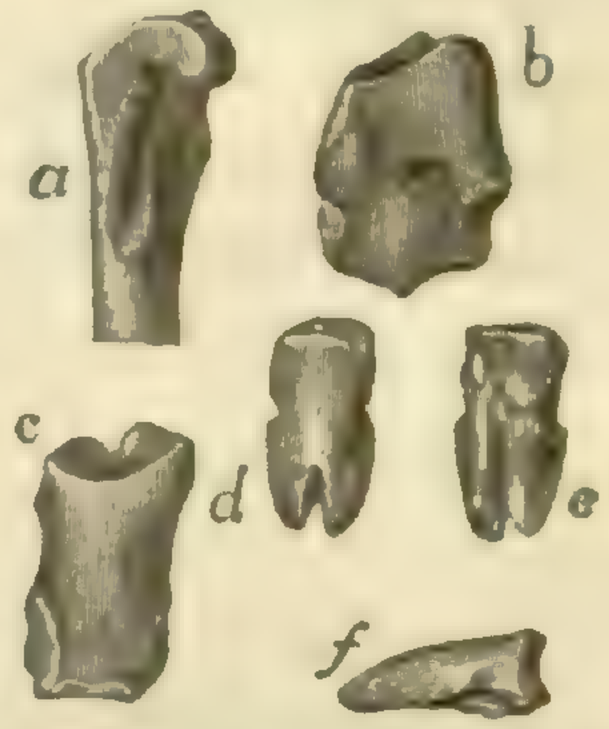


FIG. 10. — Parts of digits of *Mesonyx ossifragus*, one-half natural size. Fig. *a*, metacarpal; *b*, metapodial, distal end; *c*, phalange; *d e f*, an ungual phalange from above, below and side. Original. From the Wasatch beds of Wyoming.

The *Sarcothraustes antiquus* is a large animal from the Puerco epoch of New Mexico, of about the size of the *Mesonyx ossifragus*. Its inferior molars have a wide heel as in Amblyctonus. The genus Dissacus Cope, occurs in the same formation and locality. Its inferior molars (Fig. 11) present an accessory cusp on the inner side of the principal cone. This constitutes the first step towards the tubercular-sectorial tooth of other families. There are two species, the *D. navajovius*, as large as the red fox, and *D. carnifex* Cope, of larger size.

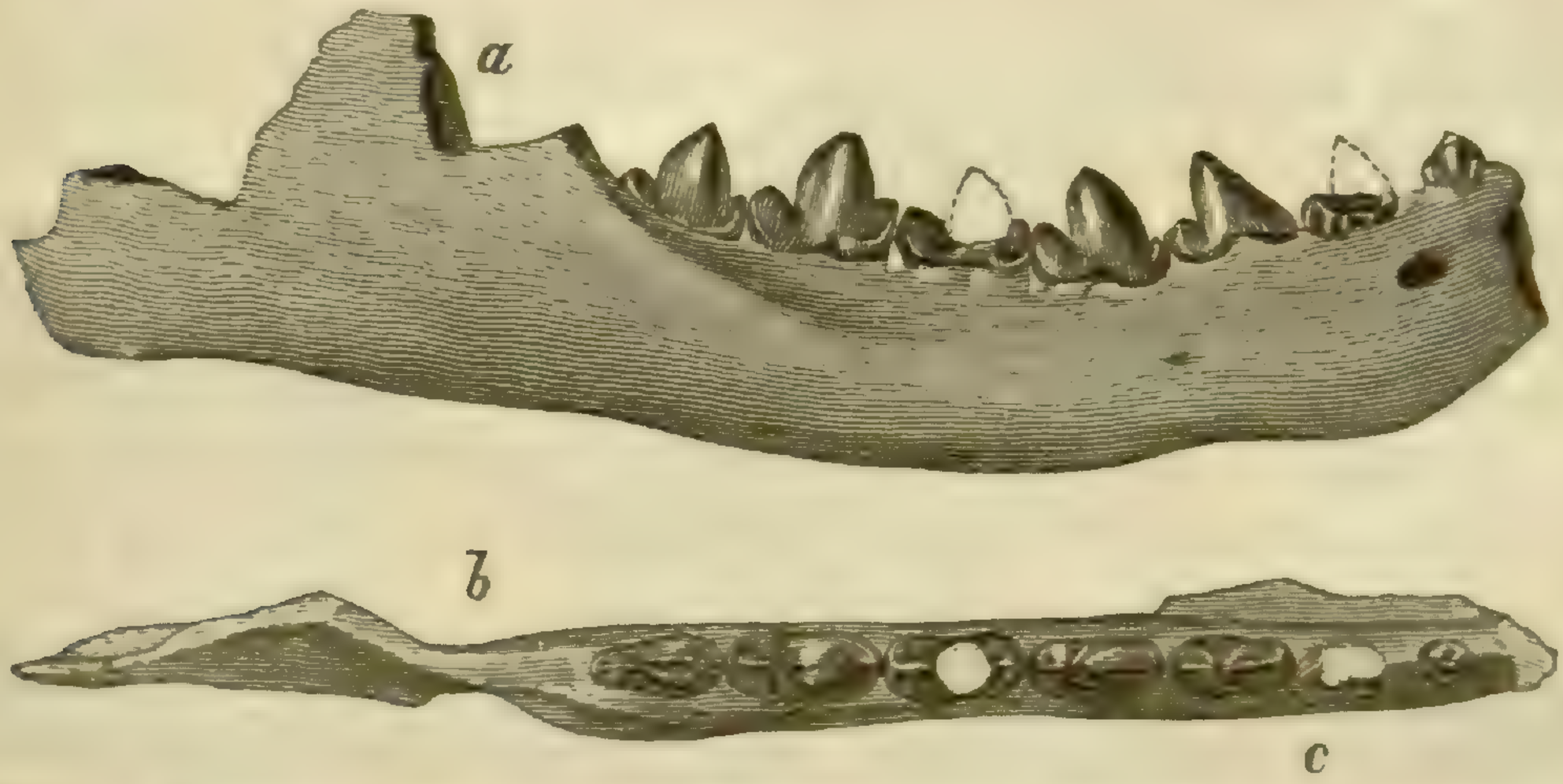


FIG. 11.—*Dissacus navajovius* Cope, right mandibular ramus, three-fourths natural size; *a*, external; *b*, superior views. From the Puerco beds of New Mexico. Original.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

— That the ordinary jury is incompetent to deal with nice questions of mental status which come before our courts receives frequent proof. And this will always be the case so long as the question of "responsibility" is permitted to complicate the question. Two recent verdicts bring this subject before us at the

present time. Nutt, of Uniontown, Pennsylvania, was declared insane by a jury who knew him to be sane, in order to avoid the necessity of hanging him for a murder which they thought justifiable. Meredith, of Philadelphia, is declared sane, although his nearest relatives testified to his monomania, and his written defence proved that their statements were correct. This was done to avoid the necessity of depriving the subject of the investigation of his liberty.

It is thus clear that our laws on this subject need revision. They should keep in view the fact that the brain is liable to temporary disorders like other organs, and that persons must not be adjudged "insane" because they have displayed insanity on one or more occasions in their history. Second, the question of "responsibility" should be subordinated to more easily understood aspects of the question. Thirdly, undoubted insanity should not be considered ground for restraining liberty in some cases, nor for escape from penalties in others. In explanation of these points we reproduce here our remarks in the NATURALIST for January, 1882, apropos of the assassination of President Garfield:

"In the first place the present definition, which only admits insanity where the criminal is unable to judge of the consequences of an act, is certainly erroneous. Persons undoubtedly insane often act with deliberate design and great forethought. It would be a safe, though not a perfect definition of insanity, to describe it as a state of mind in which acts are committed which are in direct opposition to the plain and obvious interests, not of persons affected by the act, but of *the actor*. Here the question of the ignorance of consequences is restricted to its legitimate field, the instinct of self-preservation, through which the rational faculty has originated. It is another way of stating that the emotional or sentimental elements of character have so far overcome the rational as to cause the commission of self-destructive acts. Under this definition an act of violence committed in savage society would not indicate insanity, while the same act committed in civilized society, where means of detection and punishment abound, would be properly regarded as that of an insane person.

"In such a classification, criminals are those who disregard the rights of persons and property with a *reasonable* expectation of advancing their own interests thereby.

* * * * * * * *

"The punishment of the insane should be like that of the sane criminal, designed to protect society in two ways; firstly, by restraining the criminal himself from inflicting further injury; and secondly, by furnishing persons in the community of similar mental constitution with reasons for believing that it is contrary to their interests to commit like acts. In this way the law would furnish such insane with motives which would produce a change in the balance of the mind, the result being sanity. The punishment of death is as proper in such cases as in that of sane criminals of corresponding grade. The death penalty might even be necessary in the case of that lower grade of the insane who do not understand consequences. In this case the only object sought is the protection of the community, for motives are less operative with these than with the higher class of the insane. In either, the question of moral responsibility is omitted from consideration, as being beyond the range of human knowledge."—*C.*

—— When philology and archæology together take up the same tools and work at the Aryan problem, employing the critical methods of palæontology, the results are most promising. Several works recently published converge upon the question as to the origin, or rather the birthplace of our Aryan ancestors. The origin of our domestic animals, particularly the horse, ox, sheep and pig, formerly supposed mostly to have been in Central Asia, is now shown to have been in Central and Eastern Europe as well as Western and Central Asia. The birthplace of the cereals appears to have been for the most part in Western Asia and in Europe. Any one who will, from the facts given by DeCandolle in his "L'Origine des Plantes cultivées," plot upon a map the areas where they have been found wild, will be surprised to see that most of the areas of wheat, barley, rye and oats lie in the western border of Asia and in Southeastern Europe. We are not, then, compelled to vaguely look to the highlands of northwestern India and of Central Asia for the origin of our domestic animals and plants.

And now a reviewer in the *Academy* of Dec. 8, Mr. A. H. Sayce, in noticing two recent German works on the origin of the Aryans, quotes Penka (Origines Ariaceæ), as insisting upon "the uncontrovertible, but hitherto neglected, doctrine that language alone will not interpret for us the former history of our race. Without the aid of anthropology it is not only useless but misleading." If Professor Penka depends too implicitly on the testimony of skulls, Mr. Sayce declares that Professor O. Schrader (Sprachvergleichung und Urgeschichte) has for the first time employed a thoroughly critical method in determining the character and condition of primitive Aryan society; with results "very different indeed from the idyllic picture of that civilized commu-

nity to which Pictet and other writers have accustomed us. The early Aryan comes before us as a coarse and uncivilized nomad, unacquainted with the use of metals, and protecting himself with the skins of wild beasts from the inclemencies of the climate." This Aryan society was like that of the Swiss pile-dwellers, whom, indeed, Professor Schrader believes to have been Aryan, drawing attention to the similarities between the results he has derived from his linguistic researches and the discoveries of archæologists in the ruins of the Swiss lake-dwellers of the stone age.

Professor Schrader's "linguistic palæontology," carried on, adds the reviewer, under the salutary control of archæology, leads him to the same conclusions, though by a different road, as Professor Penka, *i. e.*, that Europe, not Asia, was the original home of the Aryan family, as first suggested by Dr. Latham. Mr. Sayce tells us that this theory has recently been gaining ground, remarking: "We now know that it is to the European, rather than to the Indic languages that we must look for the truest representation of primitive Indo-European grammar and phonology. The argument, therefore, formerly used to support the claim of an Asiatic origin for the Indo-European family of speech must now be turned against it."

Penka considers the starting point of Aryan emigration to have been Scandinavia, the Aryan invaders of Northwestern India having been a later and distant offshoot of the primitive stock. Mr. Sayce has been attracted by Poesche's hypothesis, "which makes the Rokytno marshes the original center of the Aryans. However that may be, the evidence is now tending to show that the districts in the neighborhood of the Baltic were those from which the Aryan languages first radiated, and where the race or races who first spoke them originally dwelt.

Thus philology, anthropology, zoölogy and botany now unite in suggesting that the birthplace of the Aryans was in Eastern Europe and the western borders of Asia, rather than the Himalayan plateau. Our Aryan savage ancestors were probably herdsmen and shepherds as well as forest rangers, living partly on the treeless plains of Russia in Europe, and partly in the forest-clad lowlands of Scandinavia and Northeastern Germany.

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RECENT LITERATURE.

MEINERT'S ANATOMY OF THE CENTIPEDE'S HEAD.[1]—This memoir is fortunately written in English. It treats in detail of the external anatomy of the parts of the head in Scolopendra (*S. subspinipes* Kohlr.) as most typical of the Chilopods. As a contribution to the morphology of the myriopods it will always be

[1] *Caput Scolopendræ. The Head of the Scolopendra and its Muscular System.* By FR. MEINERT. With 3 plates. Copenhagen, 1883. 4to, pp. 77.

valuable, though we doubt if some of the author's views will command general assent. The details appear to have been worked out with care, while the drawings seem to have been very carefully made by the author, and beautifully engraved by Lövendal.

In the course of his lengthy views of the works of his predecessors, the author criticises and disproves Newport views that the head of chilopods is composed of eight sub-segments. Four pages of the memoir are devoted to an elaborate and useful tabular view of the opinions of forty-six authors as to the morphology and nomenclature of the mouth-parts.

Dr. Meinert gives a new explanation and nomenclature of the mouth-parts. He also claims that they are homologous with those of biting insects, or, to use his own words, set forth in an idiom peculiarly his own, "it is purposed to serve me to show the coincidence of the head of Chilopoda and its parts of the mouth with the head of the Insect and its parts of the mouth, especially in the Orthoptera, that is to say, in insects with free biting parts of the mouth, and four pairs of these parts or four metamers in the head." Here it may be remarked that Meinert does not regard the antennæ and the antennal segment as homologues of the other mouth-parts and segments. In his own words, "The real head then must be said to consist of the three foremost metamers, together with their exponents or limbs; that is to say, the labium, the maxillæ and the mandibles, and besides of the lamina cephalica, which latter, as well as its appendages, the antennæ, I by no means can consider to be homonomeous with the other metamers of the body and of the head, and with their exponents." Meinert's reasons for rejecting the view that the so-called antennal segment is not such, are weak and unsatisfactory; its form is necessarily unlike the other segments, as it constitutes a preoral segment and the front of the head; it is therefore unlike the succeeding segments, though homologous with them. He considers the antennæ as dorsal rather than "ventral (or pleural);" here we think Meinert wrong. Our author does not accept Metschnikoff's views as to the embryology of Chilopods, although the Russian's observations show plainly enough that the antennæ should be regarded as homologues of the other mouth-parts, and Sograff's splendid memoir (published, however, since Meinert's present paper) appears to confirm Metschnikoff's views. Meinert claims that "neither in the Chilopoda nor in the insects can any ventral part be pointed out in the lamina cephalica;" and he also insists that the alimentary canal does not pass through the antennal segment, or, as he calls it, *lamina cephalica*. But if any one will examine Sograff's Figs. 38, 39 and 43, we think that he will admit that Sograff fully proves that, as in insects, the alimentary canal at first opens as a mouth in the middle of the antennal segment, moving back into the mandibular segment in after life, while the antennæ arise as pleural outgrowths in almost exactly

the same manner and relative proportion as the mandibles and maxillæ. Here, as in other memoirs, Meinert lacks breadth and comprehensiveness in his treatment of arthropod morphology. We also think that there is a decided lack of homology between the mouth-parts of myriopods and hexapods, as we have endeavored recently to show, the terms labium, maxillæ and mandibles not being properly applicable to the myriopods, however alike their appendages are in the embryo to those of Hexapoda.

LEYDIG'S RESEARCHES IN ANATOMY AND HISTOLOGY.—Professor Leydig devotes the greater part of his most recent work, "Unbersuchungen zur Anatomie und Histologie der Thiere" (Bonn, 1883, pp. 174), to the discussion of the intimate structure of the tissue cells of the Insecta. A few pages treat of the tactile papillæ of the Kentucky blind fish (*Amblyopsis spelæus*), and of the olfactory cones in the cray-fish from the Mammoth cave (*Orconectes pellucidus*). As these forms have been described in detail in earlier volumes of this journal (Jan., '72, Dec., '71) some of the readers of the NATURALIST may be interested in the result of the distinguished histologist's observations.

The tactile papillæ are arranged on the top of the head on ridges, which thus acquire a pectinated appearance (see this Jour., 1871, Pl., Figs. 7, 8, 9, 10). Professor Wyman described a filament projecting out of the funnel-shaped extremity of each papilla, but Leydig denies the existence of the filament, considers that the funnel is occupied in the fresh state by a beaker-shaped sense-organ similar to those met with everywhere in the skin of Teleostei, and suggests that as the thin edge of the funnel is occasionally prolonged into several points, one of these was mistaken for a central filament by Wyman.

In addition to the larger papillæ, isolated smaller ones are scattered over the head and mucous membrane of the mouth, being most frequent on the lips. They are not visible to the naked eye, and in fact generally require the microscope for their demonstration. They are slender and cylindrical, with a slightly broader base and fringed extremity, also hollowed out for the lodgment of a "sense-beaker."

As the want of sight in the blind fish is compensated for by the development of the tactile ridges, so in various Crustacea of the "cave-fauna" it has been noticed that the olfactory cones are present to a much greater number than in allied forms possessed of sight. Professor Leydig was unable to compare *Orconectes pellucidus* in this respect with any of the other North American species, but finds that the external branch of the antennula which bears the olfactory cones has thirty-six segments. The cones are chiefly confined to the middle third of the flagellum, and are there arranged to the number of seven on each segment, three being on the middle and four in a bunch on

the distal end. The number to each segment decreases both towards the proximal and distal ends of the cone-bearing region.

On examination of the only species of which I have living specimens just now, *C. propinquus*, I find the external branch of the antennula composed of eighteen or nineteen segments. The distal nine of these alone bear olfactory cones, and only five of them (the 11th, 12th, 13th, 14th, 15th), have the full number of eight on each joint, so that *O. pellucidus* would appear to form no exception to the rule which has been noted above as to the European "Cave" Crustacea.—*R. R. W.*

STERNBERG'S PHOTOMICROGRAPHS AND HOW TO MAKE THEM.[1]—Many a naturalist who may be unskilled in drawing, or who may desire to reproduce by photography histological preparations, will be thankful for this excellent work, which so describes the technique of photomicrography as to enable one familiar with the use of the microscope to make photomicrographs with the least expenditure of time and money. The author, who is well known for his researches on disease-germs, has designed the work for beginners, who, like the author, had resorted to photography for the purpose of making pictorial memoranda of his microscopical observations.

The first part of the book is devoted to technology, and considers light, microscopical apparatus, the camera and photographic material, the arrangement of microscope and camera for photography, the operating room and fixtures, etc., the exposure and development of the plate, the fixing, intensification and preservation of the negative, as well as photographing by reflected light, and making positives upon glass. This part concludes with chapters upon the selection and preparation of objects for photographing.

The second part is devoted to a description of plates, and to a popular account of elementary histology, containing accounts of the Amœba, of Micrococci, of one celled algæ, of epithelial and other cells, blood-discs and of vegetable cells and diatoms, the microphotographs being excellent. The book is a timely and useful one, and though the plates are very useful as examples of excellent work, we are not sure that it would not have given more unity to the book to have issued the second part as a separate work. At any rate there will doubtless be a good demand for such a hand-book as the present one. It is well printed and illustrated.

MISS BUCKLEY'S LIFE AND HER CHILDREN.[2]—The title of this

[1] *Photomicrographs and how to make them.* Illustrated by forty-seven Photographs of Microscopic objects, reproduced by the Heliotype process. By GEORGE M. STERNBERG, M.D., U.S.A., etc. Boston, J. R. Osgood & Co., 1883. 8vo, pp. 204.

[2] *Life and Her Children.* Glimpses of Animal Life from the Amœba to the Insects. By ARABELLA B. BUCKLEY. 100 cuts. New York, D. Appleton & Co., 1883. 12mo, pp. 312, $1.50.

little book is designed to express, as the preface states, "the family bond uniting all living things, as we use the term, 'Nature and her works,' to embrace all organic and inorganic phenomena." Although British animals are referred to wherever possible, yet the book will be found to be most agreeable reading by our young naturalists, boys and girls. We have never met with a book better calculated to interest the young, while it is written from a high standpoint. After the youthful reader has read this, and "Winners in Life's Race," by the same author, he will be prepared to understand the evolutional questions which will come up in after reading and study. As it is, the transition from old-fashioned books about animals to the more advanced ones, prepared from an evolutional standpoint, is so sudden that the reader is sometimes thrown off his balance. The tone of the author of "Life and her Children," while liberal, is also reverential.

The illustrations of the marine animals have been prepared by Dr. Wild, artist of the *Challenger* expedition; they are sketchy and attractive, though not always well engraved; but they are valuable to the young reader from showing the creatures' surroundings of water, rock and ocean bottom. The drawings of the insects are indifferent, as are the lithographic plates. The book will be excellent reading in connection with school work.

HANSEN'S STRUCTURE OF THE MOUTH PARTS OF DIPTERA.[1]—The author adds another to the series of works now appearing on the structure of the mouth parts of the Diptera, which is one of the most difficult subjects in insect anatomy, and one requiring both close observation and good powers of generalization, particularly in comparing these highly modified parts with those of other insects.

The descriptive part of the work is preceded by a full historical account of the work of others, from Swammerdam to the recent writers, such as Dimmock, Becher, Meinert and Kraepelin. As the essay is written in Danish, we can only say that it bears the appearance of having been prepared with great care and thoroughness. Fortunately there is a Latin abstract or "Conspectus systematicus," of the chief results, which will make the treatise vastly more useful to the English student. Besides this the explanations of the plates are both in Danish and Latin. The figures have been beautifully drawn by the author, and exquisitely engraved on copper by Lövendal, the prince of living zoölogical engravers. The sketches are characterized by clearness and accuracy. We only wish that they could have been drawn on a larger scale. So far as we are aware this is the most important entomotomical essay of the year.

[1] *Fabrica Oris Dipterorum: Dipterernes Mund i Anatomisk og Systematisk Henseende.* Ved H. J. HANSEN. Cand. Mag. 1te afdeling. (Tabanidæ, Bombyliidæ, Asilidæ, Thereva, Mydas, Apiocera.) Med 5 Kobbertavler. Kjöbenhavn. 8vo, pp. 230.

WHERE DID LIFE BEGIN?[1]—This brochure is devoted to the demonstration of the proposition that life made its appearance on the earth at the poles. The obvious reason for this conclusion is the fact that it was at the poles that the temperature of the earth first reached a point sufficiently low to permit life as it appears to us now. The question is discussed from both the physical and biological standpoints, and the facts of geographical distribution are brought to bear. The reasoning is good and fairly deducible from the premises. The law, while true in general, is nevertheless subordinated in its workings to questions of the distribution of land and water. We cannot, therefore, agree with Mr. Scribner in the supposition that hairy elephants and rhinoceroses have always dwelt in arctic climes, and had not migrated from tropical regions in earlier ages. The land of the arctics which belongs to the possible age of higher mammals is of later geologic age than that of the south, so that many of the terrestrial types of animals and plants have of necessity originated in southern regions.

GEOLOGICAL REPORT OF INDIANA FOR 1882[2]—This useful volume comprises the results of further surveys of different counties, besides containing an outline of the geology of the State, with an outline map. It likewise contains a catalogue of the flora of central-eastern Indiana by Dr. A. J. Phinney. A large proportion of the volume, with thirty-two plates, is devoted to the elucidation, by Professor James Hall, of the late Mr. Van Cleve's fossils, and manuscripts relating to them; also lengthy notes on the Spergen Hill carboniferous fossils, by Professor Hall. The report closes with a brief reference to the diatoms of the waters of Indiana accompanying six plates of figures.

MARTIN'S HUMAN BODY.[3]—This is an abridgement of the author's larger text-book on human physiology, and seems to us to be as well, if not much better adapted for general use than any other book on this subject. Teachers certainly will find it a fresh and original book, and will be aided in their work of teaching this difficult study by the appendices to many of the chapters, giving directions for the performance of simple physiological experiments. The illustrations are abundant and excellent, particularly the full-page illustrations in colors, which are well printed.

[1] *A brief inquiry as to the probable place of beginning and natural course of migration therefrom of the Flora and Fauna of the Earth.* By G. HILTON SCRIBNER. New York, Charles Scribner's Sons, 1883.

[2] *Indiana Department of Geology and Natural History.* (Twelfth Annual Report.) JOHN COLLETT, State Geologist, 1882. Indianapolis, 1883. 8vo, pp. 400.

[3] *American Science Series, Briefer Course.* The Human Body. An elementary text-book of Anatomy, Physiology and Hygiene. By H. NEWELL MARTIN. M. D., etc. New York, Henry Holt & Co., 1883. 12mo, pp. 355. $1.50.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—THE CONGO, FROM ITS MOUTH TO BOLOBO.—Mr. H. H. Johnstone (Proc. Roy. Geog. Soc., Dec., 1883) not only describes the lower course of the Congo, but gives a map and details respecting the aspect of the western coast of South Africa generally. The forest belt of Africa extends from Sierra Leone to the Ogowé, a little to the south of which it is succeeded by the park-like scenery so characteristic of South Africa. The thick forest is determined by the perpetual rains, and its absence in the country, which has a dry season of greater or less duration, is determined by the fires which, started by the natives among the long dry grass, sweep the forest from the hills. This well-timbered but open country is at first a narrow strip along the coast, but the boundary line soon bends to the east. The limit of the oil-palm (*Elais guineensis*) is approximately 10° S. lat., but along the coast it does not stretch far south of the Congo mouth. A little to the south of the Congo, between Ambrizete and Cabeca da Cobra, the park-like scenery begins to retreat from the coast, and is followed by a region of sparse vegetation, with euphorbias and aloes, and occasionally baobabs, mimosas, and figs, and where there is often less than two months rain in the year. Patches of this kind of country, broken by timber along the rivers, fringe the coast as far south as Benguela, where a belt commences and runs far into the interior. At about the 13th parallel this region of scanty vegetation gives way to absolute desert, which is a prolongation along the south-western coast of the Kalahari desert. The northward trend of the Congo brings its course above Stanley pool into the region of forest and perpetual rain.

The sandy wastes between Mossamedes and Orange river grow little but the strange Welwitschia and a few stunted Bauhinias, but the park-like country has the Hyphœne-palm, the oil-palm, the cottonwood, the baobab, figs, mimosas, numerous splendid papilionaceous trees, etc. This is also the country of the large game animals. The thick forest, where vegetable life rules supreme, shelters the anthropoid apes, which thus do not approach within 100 miles of the northern bank of the Lower

[1]This department is edited by W. N. LOCKINGTON, Philadelphia.

Congo, yet probably cross it near the equator. The gray parrot, often stated to have its southern limit at the Congo, reaches, perhaps, its greatest development in Malange, nearly 300 miles south of that river.

The single mouth of the Congo is unimposing beside the deltas of the other great African rivers, and it is not unlikely that this outlet is not of very ancient date. Many of the so-called creeks between Boma and the sea have gained in length within the memory of settlers on the Lower Congo, and seem to be attempts on the part of the river to force a new way to the sea. Banana point, a sandy peninsula at the Congo mouth, would long ago have been washed away had it not been for man's protection. The scenery of the region of the rapids, Yellala, Ngoma, and Isangila is graphically sketched by Mr. Johnstone, as also the Ntombo Mataka falls above Manyanga—the nearest approach to a cascade the river exhibits. Above Stanley pool the scenery is tropical, and the river moves swiftly between high wooded banks. Below Boma, the hottest place on the Congo, good water can be obtained from ever-running rills, so that above Vivi dysentery is almost unknown. At Msuata, above Stanley pool, the temperature ranges from 87° in the shade at noon to 60° at two in the morning.

The races between Lake Bungweolo and Stanley pool are Bantu of the purest type. On the coast the Bantu seems to have mixed with an earlier negro population. The Ba-yansi of Bolobo are perfect Greek statues in their forms, and have a civilization of their own, building houses of three or more rooms, covered with matting, and having a door of laths and matting that swings on a rude hinge. Their pottery, weaving, decoration, metal work in iron and copper, attempts at husbandry and contrivances for fishing and bird-catching show a great advance on the tribes of the lower river. They are very free from superstitions, and have to apologize for the remains of fetish among them.

Most of the fruits and vegetables grown by the tribes on the Congo seem to have been introduced by the Portuguese.

There is no large kingdom in this region, but each village is a small independent state, and this fact has, in Mr. Johnstone's opinion, greatly facilitated the entry of civilization. If one village has declined to receive Mr. Stanley, the next has welcomed him out of rivalry, so that he is now looked up to as an umpire and keeps the peace among the natives. The establishments at Vivi and Leopoldville are small towns; twenty-one stations have been founded in all, and an European can travel to Equator Station, 700 miles up the river, as safely as upon the Rhine.

The Kuilu.—At a recent meeting of the Royal Geographical Society, M. Van de Velde stated that in the spring of 1883 he had been sent by sea to the mouth of the Kuilu, while Captain

Elliot was sent by land from Isangila. The two met at Kitabi, and founded the stations of Massabe, on the coast, and Rudolfstadt, Baudouinville, Franktown, Stanley, Niadi, Stephanieville, and Philippeville further up the river. Many good native roads were found, and it is believed that a railway can be made from the coast to Leopoldville so as to avoid the rapids of the Congo.

M. Revoil's Journey in the South Somali Country.—This enterprising traveler has reached the town of Gananeh, on the Upper Juba. Notwithstanding the protection of the Sultan of Zanzibar and the good offices of the Governor of Magadoxo, and in spite of an escort of 200 men from the Somali tribe which holds the road, M. Revoil and his followers had a race for life to reach the town of Gualidi. This town is divided into six quarters, placed on both sides of the river Webbe, and is an extensive congeries of the conical huts called min, of which each Somal possesses two or three. By the end of August he reached Gananeh, and intends to go thence to the Galla country.

Geographical Notes.—Mr. Jas. Stewart, who has completed the survey of Lake Nyassa, and has been engaged in making a road between that lake and Tanganyika, died Aug. 30, 1883.——Sir John Kirk writes from Zanzibar that the rumors of the death of King Mtesa are not supported by anything known at Zanzibar.——Lieut.-Col. E. C. Ross believes that he has identified the Sitakus or Sitioganus of Nearchus and Pliny with the Kara-Aghatch, while the latter is the upper course of the Mund or Khor-i-Ziaret, the mouth of which, in the Persian gulf, is well known.——The Indian government contemplates sending an expedition to the Takht-i-Suliman, the highest peak of the Suliman range. The summit is a narrow plateau some five miles long from north to south, with a peak at each end over 11,000 feet high. It is believed that a day's observation from its summit will be the means of mapping some 50,000 square miles of the territory immediately beyond the north-west frontier of India.——Mr. Leys has visited the Padas, Lawas, and Limbang, three rivers opening into the Brunei bay, on the north-west coast of Borneo. The Limbang and Padas have comparatively large populations on their banks, while the smaller Lawas flows through a beautiful but sparsely-populated country.——The Lennard, a river of the Kimberley district, Northwest Australia, rises in the Leopold ranges, and at about thirty miles from the sea forms a delta, the northern arm of which is called the Meda, and the southern the May. The grass on these rivers was remarkably luxuriant. A large river (the Robinson) and several running streams, all lined with trees and densely grassed, were discovered by the Hon. J. Forrest. The country as a whole is thinly timbered, and the district is well adapted for raising cattle and horses.——The interior of

New Guinea has never been penetrated to any considerable distance, except along the course of rivers. Lieut. Armit only went twenty-five to thirty miles inland.——The death of M. de Brazza has been reported, but the report is now ascertained to be untrue. The *Revue de Geographie* states that harmony reigns between this explorer and the International Association.——M. de la Croix stated before the Geographical Society of Paris that he distinctly heard the detonations of the eruption of Krakatoa, though he was then at Lahat, 746 miles distant. M. Brau de St. Pol Lias informed the same society that Tolok-Betoung is now no more a seaport, since a barrier of pumice, nineteen miles in length, two-thirds of a mile in width, and from thirteen to sixteen feet deep, has, since the eruption, formed a floating jetty in front of the entrance of the harbor. The official number of the victims of the explosion is 15,000.——The Bolivian government has despatched an expedition against the Tobas (the murderers of Dr. Crevaux). M. Thouar accompanies it, and intends to survey the Pilcomayo river, and to verify the existence of its reported affluent, the Guayra.——M. Milne-Edwards has asserted before the Geographical Society of Paris that the bathymetrical map of the Atlantic ocean, published under German authority, is a work of fiction. In one place where the map marks 3000 fathoms, the *Talisman* expedition found 6000; and in another where the lead descended 3000 fathoms, the map showed 1000 only. The curves do not in any way correspond with the real relief of the Atlantic. The bottom of the Sargasso sea (3280 fathoms) is entirely volcanic, and thus the submarine fauna is poor. The soundings of this vessel will add greatly to our knowledge of the configuration of the Atlantic bed between Cape Verd and the Azores.——The Bay of Diego-Suarez, one of the finest harbors of the world, situated on the eastern coast of Madagascar, at a short distance from Cape d'Ambre, and so near the northern end of the island as to have easy communication with both the ocean and the Mozambique channel, belongs to the French, to whom it was ceded by Radama II.——Among the population of the southern portion of the western coast of Russia in Asia are some Chinese, most of whom are outlaws, but become cultivators of the soil when on Russian territory, and many Coreans.

GEOLOGY AND PALÆONTOLOGY.

THE HISTORY OF THE OREODONTIDÆ.—The following paragraphs, containing a synoptic view of the history of the Oreodontidæ, is taken from a paper recently read before a meeting of the American Philosophical Society:

From what is now known of the history of the Oreodontidæ the following conclusions may be drawn. These are especially instructive as far as they go, since they involve the causes of the rise, great development, decadence and extinction of one

of the best marked types of Mammalia the world has seen. The history of this type involves more or less the history of the life of the North American continent during the Miocene epoch of Tertiary time. It moreover involves the laws which regulate the vital success of all types of life, and which express the causes of multiplication, of energy, of weakness and of sterility.

Two lines of the family, the Oreodontinæ and the Agriochœrinæ, come to light simultaneously in geological time, the White River epoch, or the Oligocene. The latter is a higher type than the former, in its more complex fourth premolars, while it is inferior in the non-closure of the orbits posteriorly. It may then be regarded as a parallel line. It has but two generic types, while the Oreodontinæ present us with seven. So far as yet known, the Agriochœrinæ did not continue as long as the Oreodontinæ, as will be shown in tabular form below.

In the progressive modifications of the Oreodontine series, the first step was the inflation of the otic bulla (genus Eucrotaphus). This was succeeded by the coössification of the premaxillary bone (genus Merycochœrus). These changes were accompanied by a regular increase in dimensions. The species of Merycochœrus are all of the largest size, and there are no small ones. The smallest species of Eucrotaphus are equal to the largest ones of Oreodon. The fourth genus, Merychyus, while it loses none of the points already gained, shows a deficiency in its facial walls, where vacuities appear. There is the greatest range of size here: with one species (*M. major*) as large as any of the Merycochœri, we have another as large as the usual Eucrotaphi (*M. zygomaticus*), and several one degree smaller, or as large as the largest Oreodons. In the next genus the facial vacuities have attained to an enormous size. The premolar teeth become smaller, and the weakness of the narrow symphysis of the lower jaw is made up for by its coössification. The size is reduced from equal to the smallest Merychyi to that of the smallest Oreodons (genus Leptauchenia). In the next stage (genus Cyclopidius) the superior incisors disappear. Finally, the lower jaw is so reduced in front that it loses both incisors and premolars, in spite of its symphyseal coössification (genus Pithecistes).

The species may be thus arranged in accordance with their distribution in time:

White River epoch.—Oreodon gracilis; O. affinis; O. culbertsoni. Eucrotaphus jacksoni; E. major. Agriochœrus antiquus; A. major; A. latifrons.

John Day epoch.—Eucrotaphus jacksoni; E. major. Merycochœrus superbus; M. leidyi; M. chelydra, sp. nov.; M. macrostegus, sp. nov. Agriochœrus guyotianus; A. trifrons, sp. nov.; A. ryderanus. Coloreodon macrocephalus.

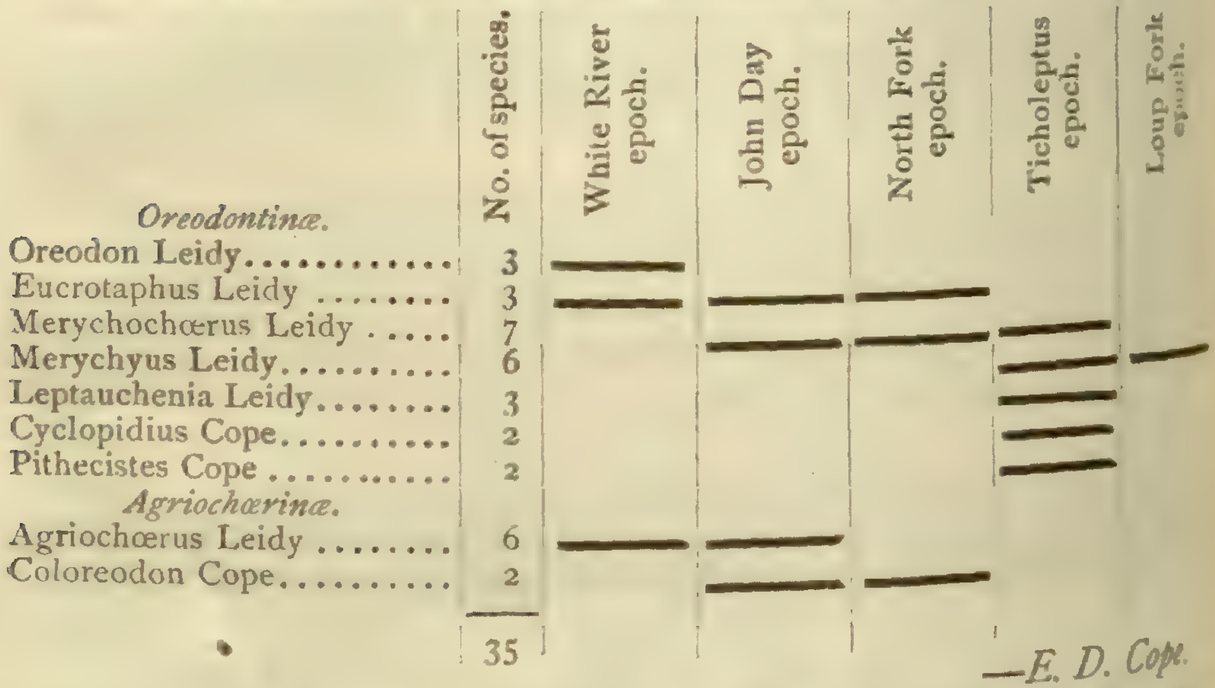
North Fork of John Day River epoch.—Eucrotaphus trigono-

cephalus, sp. nov.; E. major. Coloreodon ferox; C. macrocephalus.

Ticholeptus beds.—Merycochœrus montanus, sp. nov.; M. rusticus, M. proprius. Merychyus arenarum, sp. nov.; M. pariogonus, sp. nov.; M. zygomaticus. Cyclopidius simus; C. emydinus sp. nov. Leptauchenia major; L. decora; L. nitida. Pithecistes brevifacies; P. heterodon; P. decedens, sp. nov.

Loup Fork beds.—? Merychyus elegans; M. medius; ? M. major.[1]

The stratigraphic relations of these species may be represented under their generic heads in the following table:



—*E. D. Cope.*

Professor Owen on Fossil Mammals.—Professor R. Owen has recently described, from incisor teeth and their casts, *Scaptonodon ramsayi*, a mammal with rodent upper incisors, as in the wombat, but probably equal in size to a tapir. The microscopic characters of both enamel and dentine indicate its marsupial affinities. The remains are from the Pleistocene of Queensland. At the same meeting of the Royal Society (Nov. 15) Professor Owen described a humerus from the breccia cave in Wellington valley. Apparently this belonged to an Echidna of very large size.

At the next meeting Professor Owen described the skull of a Triassic mammal from South Africa (*Tritylodon longævus*). The teeth resemble those of Microlestes from the Keuper of Würtemberg and the Rhætic of Somerset, and those of Stereognathus from the Oölite. The fossil presents no characters to show definitely whether it was a placental or non-placental. It is evidently allied to the Meniscoëssus of the Laramie and Polymastodon of the Eocene.

Fritsch on the Permian Fauna of Bohemia.—Dr. Fritsch continues his work on the Vertebrata of the Permian gaskohle of Bohemia. The last number (pp. 159–182) contains descriptions of the following species and genera: Hylonomidæ, *Hylopleuron*

[1] The question refers to the geological age.

longicostatum; Seeleya pusilla; Ricnodon copei; R. dispersus; R. trachylepis; Orthocosta microscopica. Microbrachidæ, *Microbrachis pelekani; M. mollis; M. branchiophorus.* These species are fully described and admirably illustrated. In the Hylonomidæ Dr. Fritsch includes the genera Hylonomus Daws., Smilerpeton Daw., Hyloplesium Fr., Seeleya Fr., and Orthocosta Fr. In the Microbrachidæ he is inclined to include, besides Microbrachis, the American genera Tuditanus and Cocytinus Cope.

Filhol on Eocene Lemuroids.—Dr. Henri Filhol has published in the *Annales des Sciences Geologiques* a valuable illustrated paper on the two lemuroid genera Necrolemur Filh., and Adapis Cuv. His object is firstly to show that these genera are distinct from certain American genera; and second, to describe the limb-bones and dental variations of the species of Adapis. As regards the first proposition it results from a statement by myself that the Necrolemur is identical with Anaptomorphus Cope, and the Notharctus Leidy, is identical with Adapis Cuv. Dr. Filhol shows that both these identifications are erroneous. The first correction I have already made in my forthcoming volume on the Tertiary Mammalia of the West, which has been in press about a year. I do not remember that I had published this conclusion prior to my Palæontological Bulletin No. 37, p. 318 (January 2, 1884), though it may be inferred from my language in the Proceedings American Philosophical Society, 1881, p. 154. It is also expressed in the January, 1884, number of the American Naturalist, Dec. 29, 1883. Necrolemur has three premolars and Anaptomorphus has but two. As Dr. Filhol remarks, he has made no detailed description of the teeth in his account of Necrolemur in the Recherches sur les Phosphorites de Quercy, hence the difficulty I experienced in determining at first its dental formula. The differences in the detailed structure of the molar teeth of the two genera, now pointed out by Dr. Filhol, are mostly due to differences of wear.

Dr. Filhol has obtained the canine and incisive series of Adapis, and can show that they are of generally identical structure. This discovery furnishes the needful desideratum for the distinction of that genus from Notharctus. Hitherto no characters sufficient to indicate a difference were known.

Dr. Filhol gives a figure of a nearly complete skull of *Adapis parisiensis*. His figures of the limb bones of the same species shows that they greatly resemble those of Tomitherium.—*E. D. Cope.*

The Mineral Products of the United States for 1882–3.—It is impossible to state the total mineral product in any form which shall not be open to just criticism. It is evident that the production statistics of such incongruous substances as iron ore, metallic gold and silver; the spot value of coal mined, and the

market value of metallic copper after having been transported hundreds of miles; the spot value of a crude substance like unground, unrefined barytes, and the value of a finished product like brick (in which the cost of manufacture is the leading item. such details cannot well be taken as items in a general summary. The statistics have been compiled with a view to giving information on those points which are of most interest and utility, and are presented in the form usual in the several branches of trade statistics. The result is that the values stated for the different products are necessarily taken at different stages of production or transportation, etc. Theoretically perfect statistics of mineral products would include first of all the actual net spot value of each substance in its crudest form, as taken from the earth; and yet for practical purposes such statistics would have little interest other than the fact that the items could be combined in a grand total in which each substance should be rated on a fairly even basis. The following groupings, therefore, are presented with a full realization of the incongruity of many of the items:

Values of the metallic products of the United States in 1882.

Pig iron, spot value	$106,336,420
Silver, coining value	46,800,000
Gold, coining value	32,500,000
Copper, value at New York city	16,038,091
Lead, value at New York city	12,624,550
Zinc, value at New York city	3,646,620
Quicksilver, value at San Francisco	1,487,557
Nickel, value at Philadelphia	309,777
Antimony, value at San Francisco	12,000
Platinum, value at New York city	1,000
Total	$219,756,004

Values of some of the non-metallic products of the United States in 1882 (all spot values except chrome iron ore).

Bituminous coal, brown coal, lignite and anthracite mined outside of Pennsylvania	$76,076,487
Pennsylvania anthracite	70,556,004
Crude petroleum	23,764,008
Lime	21,700,000
Building stone	21,000,000
Salt	4,320,140
Cement	3,672,750
Limestone for iron flux	2,310,000
Phosphate rock	1,147,850
New Jersey marls	540,000
Crude borax	338,903
Mica	250,000
Crude barytes	160,000
Chrome iron ore, value at Baltimore	100,000
Soapstone	90,000
Manganese ore	52,500
Asbestos	36,000
Graphite	34,000
Sulphur	21,000
Cobalt ore and matte	15,000
Precious stones, uncut	12,500

Asphaltum	$10,500
Corundum	6,250
Pumice-stone	1,750
Total	$226,156,402

Résumé of the values of the metallic and non-metallic mineral substances produced in the United States for 1882.

Metals	$219,756,004
Mineral substances named in the foregoing table	226,156,402
	$445,912,406
Fire-clay, kaolin, potters' clay, common brick clay, terra-cotta, limestone used as flux in copper and lead smelting, iron ore used as flux in lead smelting, pyrites (for acid making), zinc white made directly from ore, marls (other than New Jersey), apatite, gypsum, tin ore, bismuth, arsenic, iridosmine, mill-buhrstone and stone for making grindstones, lithographic stone, talc (other than "soapstone"), quartz, feldspar, fluorspar, terra-alba, chalk, crude mineral paints, nitrate of soda, carbonate of soda, sulphate of soda, native alum, ozocerite, mineral soap, strontia, etc.—certainly not less than	8,000,000
Grand total	$453,912,406

The grand total might be considerably reduced by substituting the value of the iron ore mined for that of the pig iron made; by deducting the discount on silver, and by considering lime, salt cement, borax, etc., as manufactures. It will also be remarked, that the spot values of copper, lead, zinc and chrome iron ore are much less than their respective values after transportation to market.

[Abstract from a report entitled "The Mineral Resources of the United States," by Albert Williams, Jr., chief of Division of Mining Statistics and Technology, United States Geological Survey, for the calendar year 1882 and the first six months of 1883.]

Geological Notes.—*General.*—Among the volumes issued by the U. S. Geological Survey is a review of the non-marine fossil Mollusca, by C. A. White. The work is illustrated with thirty-two plates. Mr. White notices that five of the types that are recognized among the fauna of the Laramie group, Bathyomphalus, Cerithidea, Pyrgulifera, Melanopsis and Melania, have never been found among the living fauna of North America, but are represented by living species in the old world. The ten species of Unio described by Dr. Lea are referred to living species. Professor Hall believes that the two bivalves, *Cypricardites catskillensis* and *C. angustata*, described by Vanuxem from the Lower Devonian, truly belong to Anodonta. These excepted, the earliest Unionidæ known are two or three species collected by Professor Cope in the valley of Gallinas creek, New Mexico, from strata of Triassic, or perhaps Jurassic age.—M. Petiton (Bull. Soc. Geol. France, 1883) gives a sketch map of Lower Cochin China, showing the vast recent deposits of the Mekong delta,

extending over the whole of the peninsula that terminates at P. Camao. The interior of this peninsula, and large areas in the Me-kong, are completely marshy. Further north, on the Gulf of Siam, is a sandy tract traversed by granitoid mountains, and with a mass of sandstone in the center. In the north of the region is a porphyritic mass and one of sandstone. The chief mountain mass is to the west, in Baria and Bienhoa, and consists of four separate chains of granitoid rocks. A great part of Bienhoa, Longh-Thanh and Baria is covered with an extensive deposit of ferruginous clay, often containing so much iron as to become a veritable iron ore. This is often used as a building stone, and even at Saigon for macadam, a use for which its friable nature unfits it. M. Petiton states that in Cambodia, in many mountains to the north of Udong and to the west of the River Toule Sap, he has found microgranulite, granulite, porphyry and petrosiliceous porphyry. To the east of the river lies the mountain Pnom Neang Canh Rey, composed of the last named mineral, and iron mines and lime quarries also exist in the region. To the south-west of Pursat commences the enormous formation of more or less porphyritic sandstone, which extends thence westward into the Siamese province of Battambang. Very little stratification has been yet met with in Lower Cochin China, and the only fossil found was an encrinite in the limestone of Hatien.

Silurian.—Axel Tullberg contributes to the Zeitschrift der Deutschen geologischen Gesellschaft, a review of the Silurian beds of Scania, with a comparison with other similar formations. The Silurian beds of Scania are both palæontologically and petrographically very different from those of Northern Sweden. The Silurian of the islands Oeland and Gothland, East and West Gothland and Dalecarlia is, in great part, composed of limestone with a rich fauna of trilobites, brachiopods, cephalopods, corals and crinoids; whilst in Scania the limestone is much reduced and the great mass of the strata consists of graptolite-bearing schists. The thickness of the Upper Silurian is estimated at from 1480 to 1780 meters. This is distinguished into three stages, of which the middle one, the Cyrtographic shales, is about 350 meters thick, and the lower, or Rastrites shales, 120 meters thick. The upper stage of the Upper Silurian is in parts represented by about 1000 meters of Cardiola shales, the equivalent of the Ludlow shales of England; while four other groups which are locally developed correspond to the Dowton sandstone and Aymestry limestone of that country. The Lower Silurian beds are of grey limestones and shales. These strata have a thickness of 300 meters, while the Cambrian or "primordial Silurian" is only some 120 meters thick.——F. Nœtling (Zeit. Deut. Geol. Gesell. 1883) has a note upon the systematic position of the genus Pleurambonites, and describes two new forms, *P. schmidtii* and *P. haueri*. Both occasionally occur in boulders. Comparison of the characters

ters of the valves and internal supports leads our authority to place Pentamerus and Porambonites in the same family Porambonitidæ. The genus Porambonites leads upwards towards the Strophomenidæ, while Pentamerus points towards the Rhynchonellidæ.

Devonian.—E. Kayser (Zeit. Deut. Geol. Gesell., 1883) describes two new goniatites and four new brachiopods from the Devonian of the Rhine.

Carboniferous.—In the *Geological Magazine*, Dec., 1883, Mr. H. Woodward continues his synopsis of the genera and species of carboniferous trilobites, characterizing four species of Brachymetopus, one of which is new. The same writer has also some notes on the nature of the two pits, or pores, placed one on each side of the glabella, in front of the compound eyes. He inclines somewhat to the belief that they may, as suggested by Mr. J. Young, be the marks of ocelli, such as occur in the Merostomata, both recent and fossil. If so, this would be further evidence of the affinities of both groups with the Arachnida. The pore is, however, present in the isopodous genera Sphæroma and Serolis, as well as in Limulus.

Permian.—H. Credner (Zeit. Deut. Geol. Gesell., 1883) contributes a fourth article upon the Stegocephali of the Rothliegenden near Dresden. *Branchiosaurus gracilis*, *Acanthostoma vorax*, *Melanerpeton spiniceps* and *Discosaurus permianus* are described. The last belongs to the family Limnerpetideæ.

Mesozoic.—Emil Haug (Neues Jahrb. für Min., Geol. und Pal.) reviews the so-called Chætetes of the Mesozoic strata. Of these he describes *Monticulipora recubariensis* from the Trias; *Chætetes beneckei*, a true Chætetes, from the gray limestone of the Lias of Southern Tyrol, and *Pseudochætetes polyporus*.

Tertiary.—The ninth volume of the Memoirs of the Swiss Palæontological Society contains a report upon the chelonians of the Vaudois molasse preserved in the Museum of Lausanne, by Dr. Portis. Three new species of Emys, one of Kinosternon, one of Cistudo, three of Trionyx are described, and a list of twenty-five species is given. In an appendix the same writer describes the new genus and species *Polysternon provinciale* from the Upper Cretaceous of Fuveau. The plastron of this species is peculiar from the presence of a pair of osseous plates between the hypoplastrons, which are very much shortened, and the xiphi-plastrons. These are styled by Portis prosteto-plastrons. The memoir is illustrated by twenty-nine plates.——Dr. Lemoine describes four species of Adapisorex, distinguished by the variable dimensions of the maxillaries and the well characterized form of the last premolar. These are *A. gaudryii*, *chevilliomii*, *remensis* and *minimus*. All are of very small size and, as signified by the generic name, have affinities with the Tertiary Adapis on the one

hand, and on the other with the recent Soricidæ. All have been found in the Lower Eocene near Rheims.

Recent.—F. E. Geinitz (Zeit. Deut. Geol. Gesell.) states that the observations he has made during the last four years on the eastern part of the Mecklenburg coast prove that it is now sinking. ——F. Noetling (*loc. cit.*) gives a catalogue of the Diatomacea of the diluvium of Western Prussia, with particulars respecting the manner and quantity of their occurrence.——M. Virlet d'Aoust (Bull. Soc. Geol. France, 1883) contributes some valuable remarks upon the incessant formation of minerals, in various rocks, by means of molecular transport and displacement. A geode containing a small bell of the Gallo Roman epoch is referred to, found probably in an ancient alluvial deposit at Conde'-sur Iton. M. d'Aoust states that he has proved that all flint geodes, buhr-stones, etc., are the result of molecular movements that have taken place since the formation of the rocks, and that limonites and the iron ores of alluvial beds have the same origin and are still in course of formation. He instances a geode found in a vine at Perigueux, a veritable eagle-stone,—hematite enclosing 200 silver pieces of coin of the fifteenth and sixteenth centuries. The re-formation of flint where buhr-stones have been taken out, is spoken of as a fact known to the quarrymen, as also that of grains of iron ore in alluvial clays.

BOTANY.[1]

The August Flora of the Dismal Swamp and vicinity.—The celebrated Dismal Swamp occupies the greater part of five counties, viz., Nasemond and Norfolk counties in Virginia, and Gates, Camden and Pasquotank counties in North Carolina, covering in all some 300 square miles of surface. A large portion of this vast area, being practically inaccessible, is still unexplored.

The swamp begins about ten miles south-west of Norfolk, and is best reached by taking passage on a small steamboat which plies between that place and Elizabeth City, N. C., *via* the Dismal Swamp canal. This canal passes within three miles of Drummond's lake, with which it is connected by a feeder. There are three or four places in the swamp where the boat makes regular stops, but there is no hotel, or even a decent cabin, within twelve miles of the lake.

The water in the canal is of a sinister blackness, very suggestive of malaria and chills, yet it is both healthful and palatable, and the swamp is the only locality on the southern coast entirely free from malaria. The water has the bitter flavor of tannic acid, derived from the juniper vegetation of the swamp.

A considerable population of whites and negroes subsist by the lumber trade, which is the great industry of this region, although

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

there are many good farms along the line of the canal. The soil is a bottomless peat bog which, when drained and sweetened with lime or oyster shells, produces fabulous crops of corn and tobacco.

The prevalent forest growth consists of *Taxodium distichum* (bald cypress), *Cupressus thyoides* (white cedar), *Juniperus virginiana* (red cedar), *Magnolia glauca* (sweet-bay), *Acer rubrum* (red or swamp maple), *Nyssa multiflora* (sour gum), *Liquidambar styraciflua* (sweet gum), and *Quercus aquatica?* (water oak).

The following herbaceous and arborescent plants were found in flower or fruit in the neighborhood of Drummond's lake during the second week in August: *Vesæa verticillata* (swamp loosestrife), *Saururus annuus* (lizard's tail), *Callicarpa americana* (French mulberry), *Jussiæa decurrens*, *Ludwigia alternifolia* (false loosestrife), *Rhexia virginica* (meadow-beauty), *Rosa carolina* (swamp rose), *Rubus occidentalis* (black raspberry), *Smilax rotundifolia* (green-brier), *Sabbatia paniculata* (American centaury), *Passiflora incarnata* (passion flower) and *Clethra alnifolia* (white alder). The latter in some places is so abundant that the air is as heavy laden with its perfume as "the zephyrs that wax faint o'er the gardens of Gull in their bloom." The white water lily (*Nymphæa odorata*) is very abundant in the canal, but the yellow water lily (*Nuphar advena*) is scarce, as is also *Pontederia cordata*, although the latter two are abundant in the Pasquotank river, into which the canal empties. The rush family is represented by two species of Juncus; the sedge family by the genera Hemicarpha, Scirpus, Rhynchospora and Carex; all of which are superabundant. The grass family is represented by the genera Aurundinaria, Cynodon, Glyceria, Poa, Paspalum, Briza, Uniola, Setaria and Leersia. I observed no specimens of Zizania, Andropogon, Erianthus nor Sorghum. The fern family is represented only by *Onoclea sensibilis* (sensitive fern), *Woodwardia virginica* (chain fern) and *Aspidium noveboracense* (shield fern).

The southern moss (*Tillandsia usneoides*) is abundant, usually growing on the bald cypress, but frequently on the gum trees. This moss, together with the canebrake (*Aurundinaria macrosperma*), give a decided sub-tropical aspect to the scenery.

Resuming our journey by boat from Drummond's lake, we are, in a short time, out of the canal and steaming down the Pasquotank river towards Elizabeth City, N. C. The latter place lies just beyond the southern extremity of the swamp. The land here is higher and dryer, and covered with a heavy growth of yellow pine, though there are many swampy places. In some of these swamps I found *Asclepias paupercula*, *Spiræa tomentosa* (steeple-bush), *Xyris caroliniana* (yellow-eyed grass), *Habenaria ciliaris* (yellow-fringed orchis), *Pardanthus chinensis* (blackberry lily), *Lilium superbum*, *Sagittaria pusilla* (arrow-head), *Polygala*

lutea (milkwort), *Nuphar advena* (yellow water lily) and *Pontederia cordata* (pickerel-weed).

In a damp, shady dell along the Pasquotank river, I discovered the rare *Hydrolea affinis*, *Lobelia cardinalis*, *L. syphilitica*, *L. spicata*, and a form of *Rhexia virginica*, with pure white petals, are abundant, and in such places is usually found a tangle of *Clematis viorna* (leather flower), *Centrosema virginianum* (butterfly-pea), *Apios tuberosa* (wild bean) and *Mikania scandens* (climbing hempweed). The river at this point is somewhat brackish, and along its margins *Spartina polystachya* (cord grass) grows sparingly.

The "pine openings" on the uplands are usually carpeted with *Sabbatia angularis* and Stylosanthes, Lespedeza, Desmodium, Crotalaria, Medicago and other Leguminosæ. On a barren heath, a short distance from the town, I found a thrifty colony of *Rosa bracteata*, which has not heretofore been found growing without cultivation north of Mobile, Ala.

In addition to the above, almost all the plants found in the Dismal Swamp are also found growing in this neighborhood where they may be collected with much less trouble than in the swamp.

The flora of the swamp, it must be confessed, is rather tame and monotonous, but if it were possible to penetrate into the remoter fastnesses many new names would doubtless be added to systematic botany.—*Gerald McCarthy, Washington, D. C.*

Laboratory Notes.—1. *Development of Pollen.*—A most interesting and suggestive laboratory study consists in watching the development of pollen. I have found two plants especially valuable for such study, viz., Scotch pine and the common lilac. In the pine the student should commence work as soon as the clustered flowers begin to show themselves in early spring. Carefully made cross sections, made at intervals of a few days, show the gradual development first of the mass of mother-cells and later of the pollen itself. By care there is little difficulty in observing the prothallial cells in the young and thin-walled pollen cells.

The lilac is also easily studied, on account of its flower buds being so massed together as to permit the ready making of cross sections. In this case again the work must begin early, and should continue at intervals of a few days until the pollen is fully developed.

2. *The flow of Sap (water).*—A neat demonstration of the current explanation of the cause of the flow of water from trees in early spring may be made as follows: During a cold day cut a small branch from a maple tree, bring it into the laboratory and warm it quickly, when the water will flow freely; now cool it, when the flow instantly ceases; warm again, and the flow will be resumed, and so on.

Allen's Characeæ Americanæ Exsiccatæ.—We have, from time to time, noticed this important publication of specimens

these little-known plants. Fasciculus IV, just received, brings the number of species up to forty. As with the previous fasciculi, the specimens are excellent, and the labeling leaves nothing to be desired. The species are as follows: *Nitella tenuissima*, *N. glomerulifera*, *N. opaca*, *N. minuta*, *Tolypella comosa*, *T. fimbriata*, *T. intertexta*, *Chara hydropitys*, var. *genuina*, *C. sejuncta*, *C. gymnopus*, var. *armata*. A New Zealand species, *Nitella tricellularis* is also added.

The specimens were almost entirely collected in New York and New Jersey, indicating that they are, without doubt, to be found abundantly almost everywhere throughout the country, if collectors will but search carefully for them. These fasciculi are not sold, but may be obtained in exchange for specimens of Characeæ. One hundred specimens of any desirable form will be considered equivalent to a fasciculus in exchange. All correspondence and specimens should be addressed to Dr. T. F. Allen, 10 East 36th street, New York city. May we not ask the readers of the NATURALIST everywhere to keep a sharp lookout for the Characeæ?

BOTANICAL NOTES.—In the Proceedings of the Davenport Academy of Sciences, Vol. IV, Dr. C. C. Parry publishes a paper on the species of Arctostaphylos, natives of the Pacific coast of the United States. A new species (*A. oppositifolia*) is described from Lower California.——In another paper in the same volume, Dr. Parry describes four other new species from Southern and Lower California, viz., *Phacelia saffrutescens*, *Ptelea aptera*, *Polygala fishiæ*, *Gilia orcuttii*.——Dr. Gray's paper in the December *American Journal of Science*, on "Some points in Botanical Nomenclature," should receive a thoughtful reading by all our systematic botanists. It is to be hoped that DeCandolle's "Nouvelles Remarques sur la Nomenclature Botanique," of which Dr. Gray's paper is a review, will soon appear in English dress in this country. Uniformity of usage in matters pertaining to nomenclature is so desirable, that no one ought to consider himself fitted to describe and name a species until he has acquainted himself fully with the usages of naturalists. Every botanical library should contain the Dall Report on Nomenclature, published in the Proceedings of the American Association for the Advancement of Science, and the Laws of Botanical Nomenclature, by Alph. DeCandolle, of which an English translation by Dr. Weddell appeared in 1868.——The January *Botanical Gazette* contains a suggestive article, by Dr. Sturtevant, on the origin of domesticated vegetables. He proposes to study the origin of domesticated plants by taking into consideration their variations. He is led to infer long prehistoric culture of many American plants, as maize, pumpkin, tomato, potato, etc. Moreover, he considers it not improbable that many of our so-called natural species are but escapes from a prehistoric cultivation.——In the December *Torrey Bulletin* E. L. Greene

describes eight new species of flowering plants from S. W. United States; C. H. Peck notices a new genus (Neopeckia) established by Saccardo, while Dr. Vasey describes two new Western grasses. ——Lists of the plant catalogues of Indiana, Illinois, Michigan and Wisconsin are given in the same number by W. R. Gerard and N. L. Britten.——Henry and James Groves continue their notes on British Characeæ in the January *Journal of Botany* recording and figuring *Chara braunii*, found in Britain for the first time last September.——J. G. Baker, in the same number continues his synopsis of the genus Selaginella, bringing the number of species up to one hundred and nine.——Dr. Farlow's Notes on the cryptogamic flora of the White mountains in *Appalachia* (Jan., 1884) is an interesting contribution to our knowledge of the lower plants of this region. Six new species of fungi are described, viz., *Doassansia epilobii*, *Propolis circularis*, *Stictis tsugæ*, *Cercospora pyri*, *Ramularia oxalidis*.

ENTOMOLOGY.

Egg-laying Habits of the Egg-parasite of the Canker worm.—In our "Guide to the Study of Insects," (p. 200) we have briefly referred to a minute species of Platygaster which lays its eggs in those of the canker worm. We noticed on a pleasant day (Nov. 28, 1863, or a year or two earlier) two of these Platygasters upon two bunches of freshly laid eggs of the canker-worm moth, probably *Anisopteryx pometaria* Mann. We placed the eggs and ichneumons in a box, and returning to our room at the Museum of Comparative Zoölogy, watched the movements of the minute Platygasters with a lens of twenty-five diameters. One of them thrust its hind body down between the eggs, and while the rest of the body was still, and supported by the fore and hind legs, the wings resting on the top of the egg it was piercing the antennæ were constantly vibrating. There could be seen a slight motion of the abdomen, the ovipositor meanwhile pushing and boring into the side of the egg. The operation of ovipositon required from one to three, generally three, minutes. When the egg had been deposited in the right place, the Platygaster ran swiftly about, vibrating its antennæ more rapidly than before, until finding a suitable egg it suddenly paused, dropped its abdomen down between the eggs, and went through the same manœuvres as we have described. Sometimes it would suddenly take to its wings and fly off.

The other Platygaster kept on the under side of the loose bunch of eggs, where it found no good opportunity to oviposit. It was very uneasy, and would constantly run about from egg to egg. It would try for three or four minutes in vain to pierce the egg-shell, and we could see it thrust out its rather long, slender and sharp ovipositor, and apparently try to drill through the obdurate shell without success. It never attempted to pierce the

top or bottom of the egg, but directed its efforts to the thinner sides. It would frequently stop and clean its head with its fore legs, and the end of the abdomen with its hind legs, as a fly does. —*A. S. Packard, Jr.*

Paired Sexual Outlets in Insects.—J. A. Palmén records in the *Morphologische Jahrbuch*, 1883, the discovery in the May flies (Ephemeridæ) that the outlets of the sexual glands are paired, not only in the larvæ of all stages, but also in the imagines, and in both sexes, as had been earlier stated by Réaumer, Eaton and Joly. In the males the *vasa deferentia* pass through on the ventral side of the ninth segment two external appendages, both reproductive organs, at whose tips or sides the openings are situated. In the larvæ the female openings are not formed until after the last molt. In the females the two oviducts open on the ventral side of the hind body between the seventh and eighth segments.

Palmén suggests that the Ephemerids represent, in respect to the reproductive system among insects, a very primitive type of organization, and he concludes that the inner sexual organs of insects are built up of two different morphological elements, *i. e.*, (*a*) internal primitive paired structures (testes with *vasa deferentia*, ovaria with oviducts), and (*b*) integumental structures, such as the ***ductus ejaculatorius*** **and vagina.**

The Larch worm.—For three summers past the existence of the larch, hackmatack or tamarack, in the northern portions of New England, New York, and portions of New Brunswick and Canada, has been threatened by a saw-fly larva. This proves to be the *Nematus erichsonii*, as the transformations, habits and imago appear to be the same. From Ratzeburg's description, the habits of the American worm are evidently like those of the European species, and it is very probable that the insect is common to both Europe and Northeastern America. At any rate our species could not have been introduced with European larches, since its ravages have been committed in the wilder, less frequented portions of Maine, New Hampshire and New York, as well as on the seaboard in towns long settled. In brief, the habits of our species are as follows: The eggs are laid in the terminal young shoots of the larch from about the middle of June, in Massachusetts, to the early part of July in Northern Maine, the larvæ feeding on the leaves late in June and in July and early August. By the last of July to the first week in August, according to the latitude, the worms are nearly fully grown, while a few half-grown ones occur on the trees in Maine in the last week of August and the early days of September. It is very doubtful whether there are two broods. We will now give a more detailed account of its habits, from a report on the causes of the destruction of evergreen forests extracted from the forthcoming annual report of the Entomologist, Department of Agriculture, 1883.

The eggs had all hatched by June 23–28; few were to be found at Brunswick, although the incisions made by the female were commonly observed. The female saw-fly makes about a dozen incisions in the terminal young, fresh, green shoot, sometimes in one of the side shoots next to the terminal one; judging by the shape of the hole the eggs are of the shape described by Ratzeburg, *i. e.*, oval cylindrical and about 1.5^{mm} in length. The eggs are placed in two rows, alternating, not exactly parallel, one being placed a little in advance of the other. The eggs are inserted at the base of the fresh, soft, young, partly-developed leaves of the new shoot, which is usually by June 20–30 only

Fig. 1.

Fig. 2.

FIG. 1.—The larch saw-fly, nat. size and enlarged. Fig. 2.—The larch worm of different ages, nat. size. Miss L. Sullivan, del.

about an inch or an inch and a half in length. The presence of the eggs causes a deformation of the shoot, which curls over, the incisions being in all cases observed on one (the inner) side of the shoot. In many cases a last year's shoot was observed with the scars of the incisions on the concavity of the shoot. That the incisions were made by the saw-fly was proved by finding a freshly-hatched, but dead, larva in one of the holes. Sometimes one or two of the leaves die in consequence of the wounds made at their base.

After the foregoing lines were written we fortunately observed

a female in confinement, June 29, while engaged in the process of ovipositing; we should judge that the operation of sawing the slit and depositing the egg required not less than five minutes, and perhaps not much more than that length of time. The fly had been evidently at work for some time previous, as a number of eggs had been laid along the shoot; she had begun at the farther end and worked down to the base of the new, fresh, green shoot. She stood head downward while engaged in making the puncture, and was not disturbed by our removing the larch twig from the glass jar and holding it in our hand while watching the movements of the ovipositor under a Tolles triplet. The two sets of serrated blades of the ovipositor were thrust obliquely into the shoot by a sawing movement; the lower set of blades was most active, sliding in and out alternately, the general motion being like that of a hand-saw. After the incision is sufficiently deep, the egg evidently passes through the inner blades of the ovipositor, forced out of the oviduct by an evident expulsive movement of the muscles at the base of the ovipositor. The slit or opening of the incision after the egg has passed into it is quite narrow and about $1\frac{2^{mm}}{6}$ in length. While engaged in the process the antennæ are motionless, but immediately after the ovipositor is withdrawn they begin to vibrate actively, the insect being then in search of a site for a fresh incision.

After making the foregoing observations we found at Phillips, Me., July 1, and at Errol, N. H., July 4, numerous twigs containing eggs, and the flies were also observed upon the trees ovipositing. Although the slit is at first closed, as soon as the embryo increases in size the twigs swell where they have been incised by the ovipositor, and the slits enlarge or gape more or less, becoming much larger and more conspicuous than when the eggs are first deposited. It would thus appear that oviposition takes place about a week later in the vicinity of Brunswick, Me., than in Essex county, Massachusetts, and about a week later in Northern Maine and New Hampshire than on the coast at Brunswick.

When the larva hatches the incision gapes open, leaving an oval hole. Out of this gape the larva creeps, and it rarely eats the terminal shoot, but crawls upon the leaves of the whorls next to the terminal shoot. At first it nibbles one side of the needle or leaf, leaving it half eaten and rough, serrate, and partly withered along the edge. The half-eaten, withered leaves of unequal length in a whorl on the ends of the smaller branches enable one to detect the presence of the young worms on the tree.

Usually after the young larvæ have shed their first skin, they collect on the verticils of the larch and almost invariably begin to eat the needles, one after another, beginning at the distal end and eating the leaf obliquely until only a short stump is left; in this way one verticil after another is eaten, and when the worms are

half-grown they occasionally collect around the main stem of the twig in singular clumps or clusters, the hinder part of the body curled over their backs, and, owing to their oblique posture in reference to one another, appearing like a ball of worms. This singular appearance was briefly noticed by Ratzeburg. The castings or excrement are long, cylindrical, more or less truncated at each end. Our saw-fly differs slightly, as has been described, from the German in the eggs being laid at the base of the leaves on the newly-grown shoots, rather than on or just under the epidermis of the last year's shoots, where we have repeatedly and in vain searched for them. The larvæ were observed to hatch out from June 20 to 30 at Brunswick, Me.

The worms appear to attain their full size in about five to seven days after hatching; certainly less than or not more than ten days. There appear to be but three molts or changes of skin, *i. e.*, four stages of the larva. In casting the skin the head splits open along the median line of the vertex, and the epicranium or sides of the head split apart on each side, leaving the clypeus and labrum in place; then the body is drawn out of the rent, the skin adhering to the needle or leaf.—*A. S. Packard, Jr.*

The Hemlock Gelechia.—During the spring of 1883, the hemlock trees, large and small, in the vicinity of Providence, R.I., were observed to be much disfigured by the attacks of a small Tineid worm, causing sere and dead patches of leaves on the smaller branches and twigs of both large and small trees.

The small pale-green caterpillars bite off from six to eight leaves, constructing a broad, flat, irregular case; the leaves on being separated from the twig turning red or yellowish, thus forming a conspicuous patch. This rude case is held together with silk, the worm living in a rude silken tube, and feeding upon the inside of the leaves. The length of this tube, within which the little caterpillar finally changes to a chrysalis, is from 8 to 10^{mm} in length.

The worms are found from the first of May through the month of June. One changed to a pupa in its tube about the 20–25th of May, and the moth (in confinement) appeared June 1. Other chrysalids were found in the tubes from June 20 to 30, the moths making their appearance early in July. The larva, pupa, and moth are described in the report for 1883 of the Entomologist, U. S. Department of Agriculture.

The moth (*Gelechia abietisella*, n. sp.) is beautifully marked, and probably examples occur throughout the summer. Without doubt the eggs are laid on the twigs or leaves in the summer, and the caterpillars become almost full-fed before the winter, hibernating in their cases, becoming active in the spring. The worms are preyed upon by an ichneumon, the oval cocoon with one pupa which had recently transformed, and another ready to imaginate, occurring in the cases June 9th.—*A. S. Packard, Jr.*

FOOD-PLANTS OF THE ARMY WORM.—In Bulletin No. 3, Entomological Division, Dept. Agriculture, some new facts are recorded in reference to *Leucania unipuncta*, and notably an account of its injury to cranberry bogs. We quote the following in reference to its food-plants:

"The normal food-plants of the army worm are found among the grasses and grains, not a single species of either, so far as known, coming amiss. Wheat and oats seem to be its favorite among the small grains, though rye and barley are also taken with less relish. German millet, corn and sorghum, particularly when young and tender, are eaten by the worms. They were found, in 1881, feeding to a greater or less extent on flax in Illinois, although this is mentioned by Fitch as one of the crops which the worms will not touch. They have also been reported to eat onions, peas, beans and other vegetables, though probably only when pressed with hunger. As stated in our Eighth Missouri Report, upon the reliable authority of Mr. B. F. Mills, of Makanda, Ill., they have also been known to eat the leaves of fruit trees. Ordinarily clover is disregarded by the worms, though they occasionally nibble at it. A timothy field is often eaten to the ground, leaving the clover scattered through it standing. In this connection it may be well to state that on the Department grounds at Washington the newly-hatched worms have been found in a folded clover leaf, feeding thus protected, and under such circumstances as rendered it probable that they had been hatched there.

"Mr. Lockwood stated in his report (see last Annual Report of this Department) that even the common ragweed (*Ambrosia artemisiæfolia*) was eaten clean by the worms, and also that the worms in passing through a strawberry patch devoured both the leaves of the plant and the unripe fruit.

In order to establish upon proper authority the facts concerning what the army worm will and will not eat when pushed by hunger, we conducted during the summer of 1881–'82, a series of experiments upon different plants, placing each plant in a separate breeding-cage with a few healthy half-grown larvæ. The results show an unexpected power of accommodation to plants in many families, and no resultant variation in the imagines worth mentioning.

The results are summarized below:

PAPAVERACEÆ.—*Papaver somniferum*. (Garden poppy.)

Of four larvæ all attained full growth and entered the ground. Three moths issued.

CRUCIFERÆ.—*Brassica oleracea*. (Cabbage.)

The four larvæ in this case moved restlessly about for the first day without feeding. The second day they began to feed, and by the fifteenth all had changed to pupa. In this state two died, but the other two issued as moths.

CRUCIFERÆ.—*Raphanus sativus*. (Radish.)

Of four larvæ two lived to issue as moths; one died in the pupa, and one in the larva state.

MALVACEÆ.—*Gossypium herbaceum.* (Cotton.)

All died after feeding slightly.

VITACEÆ.—*Vitis labrusca.* (Grape.)

All died without feeding.

LEGUMINOSÆ.—*Pisum sativum.* (Garden pea.)

Of five larvæ all fed abundantly; transformed and issued as moths.

LEGUMINOSÆ.—*Phaseolus vulgaris.* (Garden bean.)

All died without touching the leaves.

ROSACEÆ.—*Fragaria virginiensis.* (Strawberry.)

The four larvæ experimented on all fed for from seven to ten days and then died without transforming.

ROSACEÆ.—*Rubus strigosus.* (Raspberry.)

Of eight larvæ all fed well and all transformed to pupa; only four, however, issuing as moths.

UMBELLIFERÆ.—*Daucus carota.* (Carrots.)

The four larvæ begun feeding on the second day; all transformed; two died in the pupa state and the other two issued as moths.

UMBELLIFERÆ.—*Pastinaca sativa.* (Parsnip.)

Of four larvæ one died before transforming, one in the pupa state, and the other two issued as moths.

COMPOSITÆ.—*Lactuca sativa.* (Garden lettuce.)

Of four larvæ one was destroyed by the others before they commenced to eat; the others all fed to full growth, transformed and issued as moths.

CHENOPODIACEÆ.—*Beta vulgaris.* (Garden beet.)

Of four larvæ, after feeding slightly, three died after six days; the remaining one fed more extensively, transformed to pupa and issued as an apparently healthy moth.

LILIACEÆ.—*Allium sativum.* (Onion.)

All fed; two died as larvæ, and the other two completed the round and issued as moths.

CONIFERÆ.—*Abies canadensis.* (Hemlock.)

All died without feeding.

SALIVARY AND OLFACTORY ORGANS OF BEES.—P. Shiemenz in this elaborate paper commences with the ordinary bibliographical résumé; he describes in detail the structure of the parts of the digestive tract which bears on the question of the salivary glands and discusses their developmental history and their function. He points out that all glands have to supply a secretion, and that the more the separate cells take a larger share in this, the richer the secretion from a smaller number of secreting cells. In bees there are two essentially different modes by which this is effected and the two types may be appropriately spoken of as the *intra-cellular*, and the *intercellular*. In the simplest case of the latter we find a sac lined by a simple layer of cells, so arranged that each cell presents a proportionately broad surface to the common cavity; the material is obtained from the blood at the opposite ends of the cells. If the sac elongates, its diameter diminishes and we get the tubular form. In these two "systems" the cells are widest in a direction parallel to the lumen of the sac or tube. If the cells become spheroidal, there is a proportionate diminution in the secreting surface, and efferent canals appear between the

cells. As a matter of fact, glands of this kind of construction do, among the Apidæ, stand remarkably close to the sacular or the tubular.

The intracellular type obtains in what the author calls his first, fourth and fifth system; here the cells are attached to long stalks and float in the collum, and thus it happens that the whole of their surface is able to take up the necessary matter from the blood. In connection with consequent large secretion, secretory canaliculi are developed, which make their way into the cells, surround the plasma, and so afford a correspondingly large surface for excretion. To this type a much greater secretory activity must be ascribed than to that in which secretion is intercellular. In the so-called fourth system we find that the intercellular spaces are very rare, and in the first (Bombus) the free cells are arranged in acini. Both these arrangements must be due to the large number of cells present.

The author concludes that the so-called crop has, in honey bees, the function of, at times, completely shutting off the honey-stomach from the chyle-intestine, while the small intestine forms the means of communication between the latter and the rectum. The salivary glands vary considerably both in genera and species, and it seems proable that their functions are also very varied. While one system of glands is formed within the *propria* of the first portion of the larval spinning glands, two others are derived from its efferent canals, and the other two are fresh structures formed by an invagination of the epidermis. The olfactory mucous gland of Wolff is salivary in function.

Entomological Notes.—J. Nusbaum discusses in the *Zoologischer Anzeiger*, Jan. 7, the structure, development and morphology of Leydig's chorda, or so-called ventral vessel of Lepidoptera, which has lately been treated of by Burger and by Cattie. Nusbaum concludes that the chorda is a mesoskeleton; that it is analogous to, but not homologous with, the chorda of vertebrates, and that we may distinguish in the arthropoda, as in the vertebrates, two morphologically different parts in the internal skeleton: 1, an endoskeleton (endodermal chorda and its products); 2, a mesoskeleton (*i.e.*, Leydig's chorda).——Fritz-Müller describes in the same journal (p. 415, 16) the appendages of the abdomen in *Acræa thalia*.——Mr. A. E. Butler discusses the moths of the "Family Urapterygidæ" in the collection of the British Museum. Why the category of a family should be applied to what appears to us to be scarcely a sub-division of a sub-family of geometrids shows to what extremities systematists of an exceedingly analytical turn of mind will sometimes go. Why should not the inspection of such immense collections as those of the British Museum lead to broader taxonomical views?——The late Hermann Müller treats in *Kosmos* of the intelligence of the honey bee, and its difference in different races.——"Ants and their Ways" is the

title of a little book by W. F. White, published by the London Religious Tract Society.——The prolonged existence of Ichneumon in the pupa state is noticed by W. McRae in the *Entomologist*, p. 188.——Several interesting papers on the Collembola, by G. Brook, have appeared during the past year in the Journal of the Linnæan Society of London; among others a revision of the genus Entomobrya, of which Degeeria of Nicolet is a synonym. Packard's *Degeeria 10-fasciata*, a common U. S. species, is referred to the common European *Entomobrya multifasciata*, of which Say's *Podura fasciata* is also regarded by Mr. Brook as a synonym.

ZOÖLOGY

NOTES ON MEDUSÆ — *(Continued from February number).*— *Stomatonema reticulatum*, n. g. and s.—I have given the name of *Stomatonema reticulatum* to a new Discophore from the South Atlantic, which has affinities with Cassiopea, Aurelia, and others, and seems to me to throw considerable light on the homologies of certain peculiar bodies called "crests," found on the oral cylinder of that curious genus from the Florida Keys, known as Stomolophus.

The body is an inch and a half in diameter, is rounded, bell-shaped above, with thick gelatinous walls. The margin of the bell is much thinner than the central region, and on its floor is a fine reticulation of anastomosing tubes. The region of this network of tubes forms a narrow zone, whose outer edge is the bell-margin. There are no marginal tentacles as in Cassiopea and some other related genera of Discophora.

The marginal sense-bodies are more closely allied to those of Aurelia than to the same structures in Cyanea or Rhizostoma. The sense-bodies are eight in number, placed at regular intervals about the rim of the bell. Each sense-body is covered with a hood, and on either side, continued for a short distance beyond the sense-bulbs, is a lappet similar to like structures in the genus Aurelia. In addition to the zone of anastomosing tubes mentioned as being found on the bell margin, there are other vessels which arise from the central stomach cavity, and pass directly without bifurcation to the inner rim of the marginal network. Between these last there are still others, also straight and unbranched, which arise from the inner rim of the marginal net of tubes and extend centripetally, ending blindly in the bell substance on the lower floor.

The oral appendages of Stomatonema are characteristic. They hang from the lower floor by four attachments, in the intervals between which are placed the large globular ovarian sacs. The oral appendages are small, eight in number, and have a remote likeness to those of Aurelia. On the under side of each a groove is formed between two wing-like folds, which hang down and

border the canal on each side. These folds are continued around the oval tentacles at their distal ends, extending for about half the length of the tentacle on the upper side, and enclosing on this side a canal similar to that found below. On the edge of each of these folds there is placed a row of suckers, or "mouths," which resemble the well-known mouths in Aurelia, Cassiopea, and other similar Discophores. Each oral tentacle is thus bordered above and below by a double row of these sucking mouths. The signification of my emphasis of this fact will be seen when we come to consider their homologues in the strange genus Stomolophus.

A system of vessels for the transportation of the food from the sucking mouths to the central stomach cavity pervades the oral tentacles. Through the middle of each tentacle there passes a tube, which takes up alternately from upper and lower sides smaller vessels, passing to it from the superficial canal on the lower and likewise from that already described on the upper edges of the oral tentacles. As it nears the common fusion of all the oral tentacles, the median vessel of each tentacle becomes superficial, and opens into the groove with which it is continued on the lower surface of the oral apparatus, until ultimately it passes through a common central orifice into the stomach cavity. The two regions of suckers found on the oral tentacles we may designate as the upper and lower regions; the former being simply a continuation of the latter around the distal end of each oral appendage. The upper region of suckers is therefore morphologically the same as the lower, with which it stands in direct communication. In Aurelia the lower region of suckers ends on the lower side of the oral tentacle near its distal extremity. Does its continuation on the upper side in Stomatonema mean anything when we study the distribution of these bodies in some other genera?

The genus Stomolophus, found in Floridan waters, is a Discophorous medusa of which little is yet known, either as regards its anatomy or embryology. As far as our limited knowledge of the structure of their umbrella goes, there are many points of resemblance in the two genera. Both have the same bell-shaped bodies, and both are destitute of tentacles on the bell margin. Stomolophus is represented in the well-known figure in Professor L. Agassiz' "Contributions to the Natural History of the United States," with a reticulated zone surrounding the bell margin, which may correspond with the reticulated zone of tubes in our new genus.

In the structure of the oral region the two genera seem widely different, for while in Stomatonema we find this organ composed of eight oral tentacles, each of which is wholly distinct from the others, in Stomolophus there is a consolidated oral cylinder crossed by longitudinal lines of "crests," of which there are eight pairs. Of these crests there are two kinds, an upper, arising

from the sides of the oral cylinder which, as the medusa swims through the water, is almost wholly concealed by the sides of the bell, and a lower, in anatomical structure resembling the last, and also arranged in eight pairs in a similar manner. They are, however, disconnected from the upper, and are situated at the distal end of the oval cylinder. These "crests," particularly the upper, are raised folds or lips thrown into many ruffles, and are vertically arranged on the oral cylinder; the lower extending around the marginal rim into the mouth cavity of the cylinder. Professor Agassiz has already shown that the oral cylinder of Stomolophus may be looked upon as the homologue of the eight consolidated arms of the Rhizostome medusa. If we imagine the eight oral tentacles of Stomatonema consolidated into an oral cylinder, we would have almost exactly the morphology of the mouth-parts of Stomolophus. In that consolidation the vertical "crests" are what remains of the upper region of suckers and the lips upon which they arise, while the lower "crests" or ruffles are representatives of the lower lips and their appendages. In the fancied consolidation we must suppose a small partition between the upper and lower lines of sucking mouths, the upper crests being separated from the lower by an unbroken and consolidated section of the oral cylinder.

The genus Stomatonema approaches more closely Stomolophus than any of the Rhizostomidæ, and seems to me to confirm the theory that the formation of the oral cylinder of the latter is homologous with the consolidation of the oral tentacles. Whether this morphology of the organ in question is supported by the course of the development of the mouth must be proved or disproved by those who have opportunities to study this not uncommon medusa in Floridan waters, or on the Carolinian or Georgian coasts.

The genus Stomatonema was taken in Montevideo harbor, and a type specimen is in the Mus. Comp. Zoöl. at Cambridge.

Glossocodon and Cunina.—The interest attached to the commensalism of Cunina and Glossocodon, in which colonies of the young of the former genus are attached to various regions of the body and stomach of the latter, and the fact that both of these genera are found in North American waters, leads me to publish the accompanying sketch made several years ago (1878) at Villa Franca. Although the commensalism of Cunina and Glossocodon has never been observed in our North American representatives, the late Professor McCrady many years before (1857) discovered in Charleston harbor a *Cunina octonaria* McCr., which young lives in the bell cavity of a genus to which he gave the name of Turritopsis. It remains yet to be seen whether the species of Glossocodon and Cunina have that same intimate relationship which has been described in the Mediterranean species

by Haeckel,[1] Uljanin, F. E. Schultze, and others, between the genera Caramina and Cunina. Fritz Müller has described a like commensalism in Glossocodon (Liriope) and Cunina from South American waters. Later investigations may show that our species are the same as his, and probably stragglers from warmer southern waters. To those especially whose good fortune it is to cultivate the study of the Medusæ of these localities, we must look for new observations. On the New England coast both genera are very rare. The genus Carmarina, which has six radial tubes while Glossocodon has but four, has not been found in our waters, but from Fritz Müller's observations of *Glossocodon catharinensis*, we may expect the same or a similar commensalism in our species of the same genus.

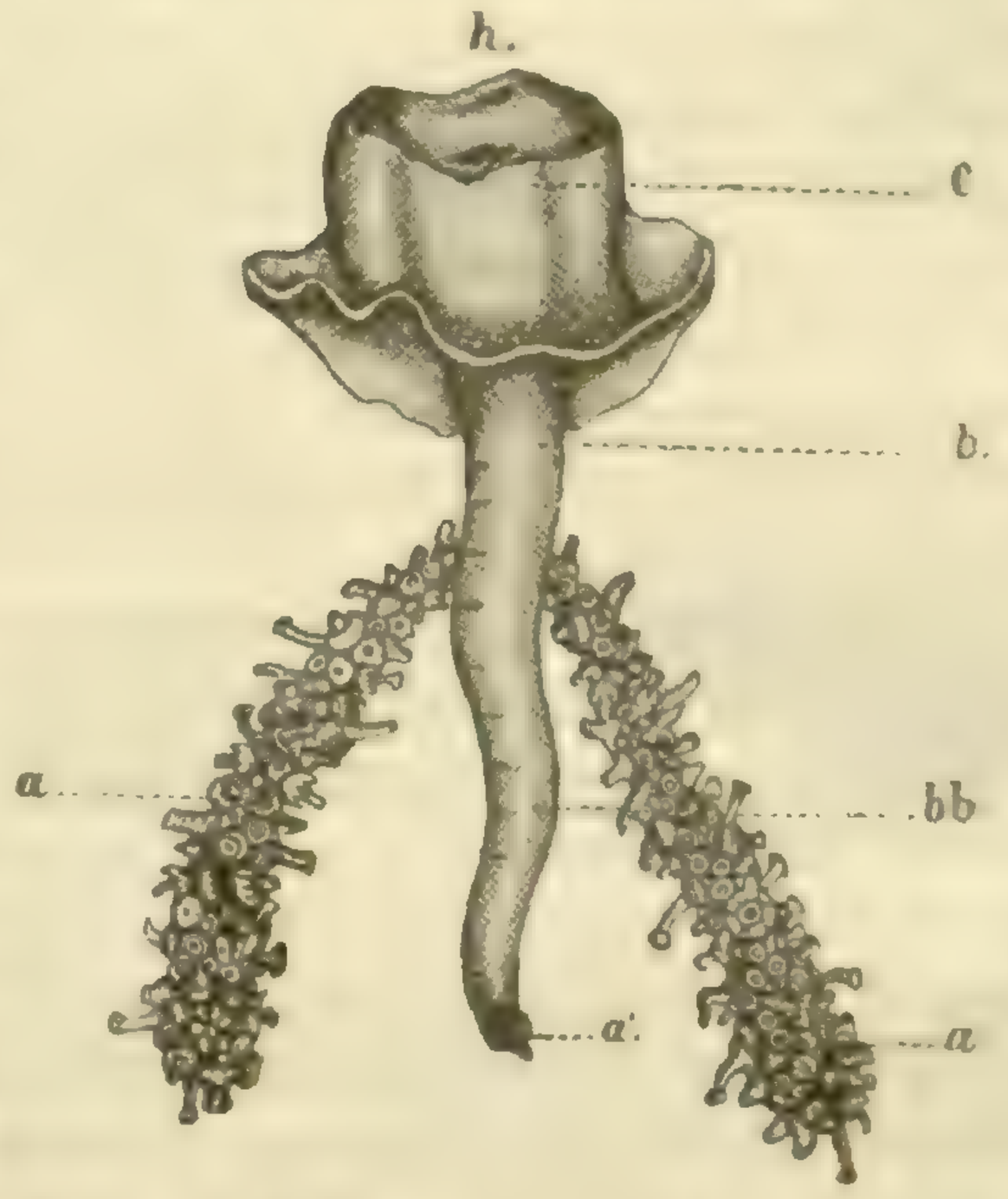


FIG. 7.—The free extremity of proboscis of Carmarina, with stomach walls cut off and tongue "columella" protruded; *a*, *a*, colonies of Cuninæ; *b*, *bb*, "Tongue" (extension of peduncle of the proboscis); *c*, base of the tongue and union with proboscis; *h*, section of the proboscis at the point where it is cut off from the attached part.

Although I have searched in vain for this relationship in our genera, many specimens of Carmarina with Cunina colonies were found during my stay in Villa Franca, where both these genera are represented more abundantly and by much larger species than those thus far known from this side of the Atlantic. My drawing of one of these, although in essentials very similar to those published by Haeckel and Schultze, shows in the same host colonies in different stages of development, where one of the three *(a)* has not yet developed a stolon, and has not advanced beyond a simple medusa form. It has a very long proboscis, a diminutive bell, and is almost identical with the youngest *Cunina octonaria* figured by Professor McCrady.

The cut (Fig. 7) represents the "tongue" *(b, bb)* of Carmarina and the terminal extremity of the proboscis *(h)*, from which it hangs. The tongue is a transparent gelatinous prolongation of the peduncle of the medusa, very similar in consistency to the wall of the umbrella, and is suspended within the stomach, protruding a little beyond the lips of the same. In order to show its whole extent, certain dissections have been necessary. The stomach walls have been removed—cut away—in order to

[1] The conception of the relationship of the two genera known as Allœogenesis which Haeckel first advanced has been shown to be erroneous.

expose this organ and its appendages, the Cunina colonies, more clearly, so that only the line of their former attachments is represented. Upon the tongue will be observed on each side an elongated cluster *(a)*, made up of spherical, flask-shaped and star-like bodies, each of which, when magnified slightly in size, will be found to be a medusa of different form from its associates, since in different stages of growth, but all attached to a common stolon which itself hangs from the tongue of the Carmarina. These clusters or colonies of young Cuninæ, as is well known, ultimately dissolve their connection with the stolon and swim away as free medusæ.

As my object in the introduction of this cut is simply to call attention to a mutual relationship of the two genera, both of which occur in our waters, I will not consider many theoretical points which are closely connected with this relationship. Let me, however, point out the very close likeness between such a colony of young Cuninæ and a Siphonophore. I have been able to confirm an important observation of Uljanin's that the Mediterranean species of Cunina does not always attach itself to the tongue of Carmarina, but is sometimes found fastened even to the walls of the umbrella. Such observations would seem to show that attachment to the tongue is not essential to the life of the young Cunina colonies. Must it necessarily be supposed that the young Cunina cannot also fasten itself to another medusa, as Professor McCrady has shown *C. octonaria* clings to the inner bell-walls of Turritopsis? If attached to the bell of Carmarina it can get little of the common food with its host. In this case is it anything more than a parasite or is it a true commensal? Observation must yet show that the attachment of one to the other is necessary for the life of either.

In studying a specimen of Carmarina with Cunina colonies I separated one of these colonies of Cunina from Carmarina and found that it lived some time in that condition. It, however, died before any of the buds attached to the stolon developed into free medusæ. The difference between such a colony of Cunina separated from its attachment and a Siphonophore is morphologically very small. If we go back in the embryological history of both, we find in the "primitive larva" of a genus of Siphonophores called Agalma a stage not widely different from the youngest medusa *(a)* immediately after it has become attached to the tongue, and prior to the formation of the stolon. The morphological resemblances between a free medusa (gonophore) and a simple fixed hydroid are very great, so great, in fact, that many naturalists have looked upon the comparison of the Siphonophore to one or the other as essentially the same thing. While, without doubt, we must regard the attached Cunina colonies as representing a hydroid stage, they seem to me to resemble more closely a budding Lizzia or Sarsia than a fixed

hydroid. Cunina has become degenerated by its parasitism or commensalism so that the proboscis with young budding from it alone remains. Its bell has gone, the mouth opening is no longer functional, and the proboscis, which has elongated into a stolon attached to the body of a host, is closely crowded with the young. The modifications which the same stolon undergoes in the Siphonophores, where it is elongated into the axis, and the changes which take place in the bell of the primitive Lizzia, by which a float or air bubble results, has been sufficiently discussed elsewhere. The most widely aberrant forms of development among the Siphonophores can be made uniform if we compare them with that of the budding Sarsia and Lizzia as the normal type. That exceptional form of development called alternation of generation which exists in the fixed hydroids may be regarded as the irregular, not the normal, method. It is an adaptation resulting from peculiar circumstances, and a departure from a rule in one direction as that of the Siphonophores is in another. The Cunina colonies have resemblances with both fixed hydroids and Siphonophores, but have not departed as widely as either from the normal method in their older larval and adult conditions.—*J. W. Fewkes, Cambridge, Dec., 1883.*

A New Pelagic Larva.—While engaged in the study of the larvæ of our marine Annelids, my attention has been directed to the close resemblance which many of them bear to the young of the Polyzoa, more especially of the entoproctous genera, Loxosoma, and Pedicellina. Several points of resemblance between Actinotrocha, the young of a Gephyrean genus called Phoronis, and the former of these two polyzoan genera in the adult condition have already been suggested by others, while the relationship between the young of the Chætopods, and the larvæ of Polyzoa have been repeatedly commented upon by those who have studied the development of both these groups of animals. The larval Chætopod worm which most closely resembles the young of Loxosoma is the well-known Mitraria, the comparisons between which have been nowhere more concisely made than by Balfour, in the first volume of his Comparative Embryology. To prove any genetic relations between these groups, other worm larvæ, even more closely related to the Polyzoa than Mitraria, ought to be discovered, and it would seem self-evident to every one that before any intimate connection between the Vermian and Polyzoan phyla can be satisfactorily made out, that a larger number of intermediate larval forms of one group or the other should be found. Such a larva, which seems to me to fill in part the gap in our comparison of the larval Annelid and the young Polyzoan, I have taken several times at Newport, and although I am at present ignorant of the adult form which it attains, it seems to me of more than ordinary interest as having to a greater extent than

any known larva, characteristics of the young of both the group of Chætopods and that of the Marine Polyzoa.

The identification at present accepted of the genus into which Mitraria is developed, is not wholly satisfactory. Mitraria was first found figured and described by Johannes Müller.[1] He speaks of three species, and regards them as the larvæ of some Annelidan genus. The next naturalist in order of time who studied Mitraria was Claparede,[2] who fished the animal with the dip-net on the coast of Scotland. Neither Müller nor Claparede observed the transformation of the larva which they had found into a worm or had anything more than a speculative knowledge of the genus to which it belongs. Schneider[3] was the first to observe a new stage in the development of Mitraria. He found that this larva, when left in his glasses, was replaced by one which he considered approximately in form that of a Gephyrean. Kowalevsky, however, according to Metschnikoff, had determined the Chætopod nature of Mitraria in 1867, although he had not published his discovery. The last step in the history of the attempts to determine the adult of Mitraria we owe to Metschnikoff,[4] who traced it into a Chætopod belonging to the family of Clymenidæ. Although he was not able to determine the genus of Annelids into which it developed, he traced it into a tubicolous worm, which has many resemblances to some of the genera of this family.

Of all known worm larvæ, that which we are about to describe has the closest likeness to Mitraria.[5] It is, however, still very far removed from it in many points of structure.

The Polyzoan larva, which it approaches most closely is Cyclopelma, the young of Loxosoma.[6] *Cyclopelma longicilictum* was first described by Busch,[7] who was, however, unable to determine satisfactorily the adult form. Leuckart[8] first suggested that Cyclopelma is the young of the entoproctous Polyzoan, Loxosoma. The new larva which I am about to describe has many affinities with Cyclopelma, as well as with Mitraria, and seems intermediate between the two.

The general form of our new larva is as follows:

Its body has an elongated, oval shape, girt equatorially by a swollen belt (*cb*) upon the margin of which the cilia are borne

[1] Arch. f. Anat. u. Phys., 1854, p. 88, Pls. v, vi.

[2] Zeitschr. f. Wiss. Zool., x, p. 407.

[3] Arch. f. Mikros. Anat., v (1869), p. 271.

[4] Zeitschr. f. Wiss. Zool., xxi, p. 233, Pl., xviii.

[5] A new Mitraria of large size, differing from any yet described, was found by me in the Bermudas in May, 1882.

[6] Let me add to Dr. Leidy's list of localities where this parasite is found, the New England coast, on Sipunculus; Professor Verrill also reports it from New England coast. (Preliminary Check-list.)

[7] Beobach. über Anat. u. Entwick. wirbellos, Thiere, 1851.

[8] Arch. f. Naturg., 1867, p. 304.

This belt, when the larva is looked at from either extremity, is oval, and has its margin deeply indented with a notch (*m*) on one side. It divides the larva into two halves of unequal size, which may be called the anterior (*a*), and the posterior (*b*). The anterior is hat-shaped and rounded at the apex. It is sometimes stretched into a thimble form (Fig. 3), at which time the belt is turned backward so that it almost wholly conceals the posterior half of the body.

FIG. 1.—Larva from dorsal side; *a*, anterior hemisphere; *cb*, ciliated belt; *cr*, ciliated apex; *ms*, pigment; *oc*, ocellus; *op*, apical projection; *p*, posterior hemisphere; *pp*, ciliated caudal prominences; *s*, setæ; *st*, stomach. FIG. 2.—Ciliated prominences, and lower extremity of larva.

The apex of the upper half of the body is rendered very prominent by reason of a tuft of cilia (*cr*). In one specimen (Fig. 1) these cilia appeared to be set on the edge of an orifice, which was widely open and bore every resemblance to a mouth. A small median prolongation (*op*) of a ridge on one side was noticed. In the walls of the larva near by was a pair of reddish pigment spots (*oc*). The union of the upper half of the embryo and the ciliated belt is marked more especially on the ventral side by opaque walls caused by pigment (*ms*) of a black color.[1] The posterior body region is smaller and more pointed than the anterior, and tapers uniformly from its fusion with a ciliated belt to two small appendages (*pp*) at the lower pole, or posterior extremity of the larva. The posterior body region is unsegmented, and the papilliform caudal appendages are covered with fine cilia. A vent opens posteriorly between these two appendages, out of which fæces were observed to pass. On the side of the posterior half of the body, opposite that in which the notch (*m*) in the margin of the ciliated belt is found, several long spines (*s*) arise, which, although not as long, resemble in general characters the spines in Mitraria. They do not spring from a single or double[2] protuberance as in Mitraria, but are appended to the side of the posterior part of the body which bears the ciliated papillæ. The true mouth was very difficult to discover, but in single specimens it could be seen in the region just below the ring of cilia in the indentation already spoken of in the margin of that structure.

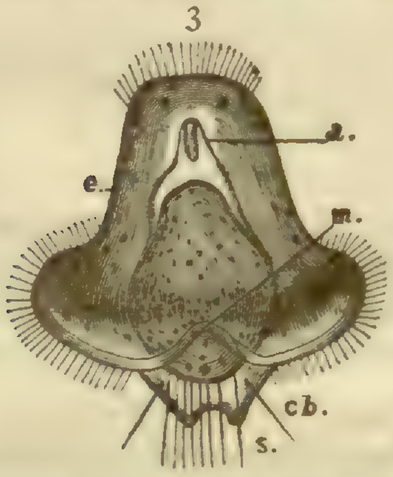
[1] This pigment calls to mind the "Mesoderme oral," in the figures of young Polyzoa by Barrois (Recherches sur l'Embryologie des Bryozoaires, Lille, 1877).

[2] See figures of species of Mitraria by Müller. In Metschnikoff's species there is a single prominence upon which the setæ arise.

The body walls, for the most part, are opaque, especially in the region of the ciliated belt, which encloses some of the most important vital organs. Within the body, however, a globular orange-colored mass (*st*) could be seen, and from it a continuation (intestine) leading downward into the posterior body region. The œsophagus, if seen, was not recognized. The upward prolongation of the walls in which the orange mass is found, as shown in a specimen with the upper hemisphere extended, was at first thought to be an œsophagus, but afterwards it was referred to a similar placed organ in Mitraria.

There are several doubtful and many anomalous features in the larva which we have described above.

The position of the internal organs, upon which so much depends in the identification, could not, from the limited material at my disposal, be satisfactorily determined. It is contrary to all homology with other Metachætæ, that the mouth should be situated at the apex of the upper hemisphere, by which the larva



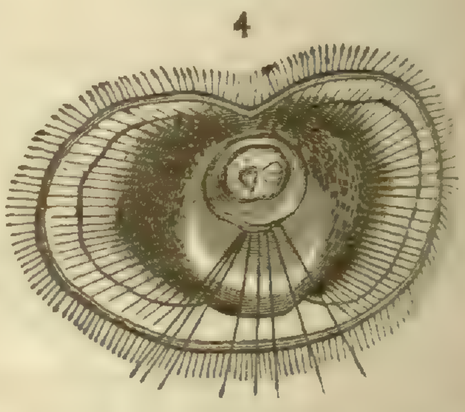


FIG. 3.—Larva with ciliated belt turned backward (ventral view): *m*, mouth.
FIG. 4.—Ciliated belt seen from below.

would be made mesotrochal. All homology with Mitraria would point to a region just below the ciliated band as the probable situation of this organ. If it really does exist here the ciliated area at the apex of the larva would be exactly homologous to the ectodermic thickening which is described by Metschnikoff as found at the apex of the upper hemisphere of the Mitraria. The apical unfolding of the wall of the body would then have an entirely different meaning from the interpretation that it is the mouth, and the cilia would be regarded as homologous to the well-known tuft found in so many genera in an homologous position.

The two ciliated protuberances (*pp*) on the posterior part of the body resemble closely similar appendages in several genera of Chætopoda. They are not found in Mitraria nor in the Polygordius larvæ. In connection with their absence in the former genera and their existence here, it may be well to quote one of the following sentences in Metschnikoff's article (*op. cit*) on the development of Mitraria. He says: "Die Abwesenheit der analen Fig-

len bei unserem Wurme kann schon deshalb nicht gegen die Clymenidennatur desselben augeführt werden, weil wir ja mehrere Repräsentanten dieser Familie (Z. B. Clymenides Clap. oder Clymenia Qtrf.) ohne die charakteristische Schwanzbildung der echten Clymenen kennen." If our larva be the young of some member of the Clymenidæ, the ciliated projections may be two of the characteristic papillæ of this region of the adult.[1]

Our unknown larva has one highly characteristic Polyzoan feature. The ciliated belt is reflexed over the lower half of the body in the same way that an homologous structure is turned back in the larval Polyzoan, Cyclopelma, mentioned above. The spines appended to the posterior region of the body are probably temporary, and are homologous with the embryonic setæ in Spio, Prionospio and several other genera. They approximate nearer the setæ of Mitraria as far as position goes, although they are not mounted on any special prominence, and arise from the posterior body region which bears the terminal ciliated prominences. In Mitraria there are no eye-spots similar to those which have been described in our new larva. In the young Loxosoma there are two well marked ocelli.

As only a single stage in the development of my new larva was found, it is impossible to do more than speculate in regard to the genus of which it is the young. There is no doubt that it is a larval Annelid, but I am at a loss to what family of Chætopoda it should be referred.—*J. Walter Fewkes.*

Barn Owls in Missouri.—As in several other parts of the country, there has been an unusual occurrence of numbers of the barn owl here this winter. Specimens were captured in four different buildings in the city and one in the country. A number of them made a regular resort of an unused chimney in a residence near the centre of the city.—*F. A. Sampson, Sedalia Natural History Society, Sedalia, Mo.*

Notes on the Red-wing Blackbird.—I examined to-day five nests of this bird (*Agælæus phœniceus*) in a prairie, though near my residence. There was but one egg in one of the nests, three in another, and four in another. One nest had a very young bird and three eggs, while the fifth nest contained four little birds about one-fourth grown. All of these but one, I am confident,

[1] It is very difficult to reconcile the hypothesis of Metschnikoff, that the Mitraria is a larval stage of a genus of Clymenidæ, and the larvæ of Clymenella figured and described by Dr. E. B. Wilson (Stud. f. Biol. Lab. Johns Hopkins Univ., Vol. II, No. 2). In none of the figures given in the excellent embryology of this worm by the latter author have I been able to find a larva which could be referred to a "Mitraria stage." If Clymenella be placed in the family of Clymenidæ, and Mitraria be the young of another member of the same, we evidently have two very different modes of development, or rather, two radically different forms of larvæ in the two. Until a larger number of older larvæ of Mitraria are known, its reference by Metschnikoff to the Clymenidæ must remain more or less hypothetical.

were old nests, which had undergone slight repairs, so that the poet Longfellow, when he wrote—

"There are no birds in last year's nests,"

could not have referred to the red-wing blackbird. These nests were built among the cat-tail flags and coarse grass and reeds which grow in the water. One of the nests was suspended upon green supports, while in the others the supporting stalks were all dead. The first-mentioned nest was evidently of recent construction, while the others had been used at least one previous season.

Opinion has varied much in the past in regard to the usefulness of this much persecuted bird. The fact that he was in the habit of eating some corn, just as it was hardening out of the milk, created a deep-seated prejudice among superficial observers years ago; but "the authorities" are all of one accord in the idea that it is one of our most useful birds. Wilson, in his time, estimated that the red-wings annually consumed in this country the vast aggregate of 16,000,000,000 of insects, the most of which were noxious! So much good work as that surely should entitle this beautiful bird to the fullest measure of protection.

But I am of the opinion that the red-wings have seen "their best days" in several of the Northern States. Some observers have occasionally found their nests in trees and bushes, and others upon the ground. But in the great prairie States its favorite nesting place is among the rank vegetation of the sloughs, ponds and the margins of shallow lakes. But settlement and cultivation are resulting in the annual reclamation of thousands of acres of these wet lands, and just now there is springing up in many regions almost a mania on the subject of tile-drainage. As all this progresses the prairie sloughs and ponds will become dry land, and cease to be the summer resorts of the red-wings. They will gradually retire and betake themselves to other and, doubtless, far-distant localities. This region has been settled about twenty-five years, and in that time I am confident that there has been quite a diminution in the vast numbers of these birds. At the present time there is little if any complaint of their raids upon the corn-fields, concerning which much was said twenty years ago. During the next decade tile-drainage and tillage will work very marked changes in the summer homes of this species, as well as its frequent associate the yellow-headed blackbird (*Xanthocephalus icterocephalus*), and many regions where they are now very abundant will doubtless only know them as occasional visitants or "birds of passage."—*Charles Aldrich, Webster City, Iowa, June 7, 1883.*

Migration of North American Birds.—At the first congress of the American Ornithologists' Union, held in New York city, Sept. 26–28, 1883, a committee on the migration of birds was appointed to investigate, in all its bearings and to the fullest extent

possible, the subject of the migration of birds in the United States and British North America. The work will not be limited to the accumulation of records of the times of arrival and departure of the different species, but will embrace the collection of all data that may aid in determining the causes which influence the progress of migration from season to season. For example, severe storms, gales of wind, protracted periods of unusually high or low temperature (for the locality and time of year) are among the atmospheric conditions that are known to exert marked effects upon the movements of birds. The opening of the leaves and the flowering of certain plants, with the correlative appearance of a multitude of insects, are also among the actors that have to do with the abundance of many species. Hence the careful registration of certain meteorological phenomena, and of the state of advancing vegetation from day to day, will constitute prominent items in the record books of the observer.

For the purpose of rendering the result of the season's work as full and valuable as possible, the committee earnestly solicits the coöperation of every ornithologist, field-collector, sportsman and observer of nature in North America. Indeed, a large corps of observers is absolutely essential to the success of the undertaking, and the committee hopes to receive substantial aid from many who profess no knowledge of ornithology. Efficient service can be rendered by those familiar with only our commonest birds, and the committee will gladly accept data concerning any of the following well-known species:

Robin, mocking bird, catbird, brown thrasher, bluebird, house wren, yellow-rumped warbler (myrtle bird), yellow-breasted chat, redstart, Maryland yellow-throat, cedarbird (waxwing, cherry-bird), purple martin, barn swallow (fork-tailed), violet-green swallow, scarlet tanager, pine grosbeak (bullfinch), purple finch, redpoll linnet, yellow bird (thistle bird), snow bunting, Eastern chewink (towhee), junco (slatebird), cardinal redbird, rose-breasted grosbeak, indigo bird, bobolink (ricebird), cowbird, yellow-headed blackbird, red-shouldered blackbird, meadow lark, oriole (hanging bird), crow blackbird, horned lark (shore lark), kingbird (bee martin), pewee (phœbe), Eastern humming bird, Eastern chimney swift, whippoorwill,[1] nighthawk,[2] kingfisher, fishhawk, wild pigeon, also any of the waders, "shore birds" and ducks.

Plan of the Work.—For convenience in collecting and arranging the enormous mass of material which will be accumulated by the joint labors of this army of field workers, it has been deemed advisable to divide the vast expanse of territory embraced in the United States and British North America into thirteen districts, each of which will be placed under the immediate direction of a

[1] When first heard.
[2] When first seen.

competent superintendent. The districts, with their respective superintendents, are:

Alaska—Supt., John Murdoch, Smithsonian Inst., Washington, D. C.

Northwest Territories—Supt., Ernest E. Seton, Assinaboia, via Carberry, Manitoba.

Newfoundland—Supt., James P. Howley, St. John's, Newfoundland.

British Columbia—Supt. (not yet determined).

Manitoba—Supt., Professor W. W. Cooke, Caddo, Indian Territory.

Canada—Supt., Montague Chamberlain, St. John, New Brunswick.

Atlantic seaboard (Lighthouses and lightships from Canada to the Gulf of Mexico)—Supt. (not yet determined).

New England—Supt., John H. Sage, Portland, Conn.

Atlantic district (New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, North Carolina. South Carolina)—Supt., Dr. A. K. Fisher, Sing Sing, New York.

Middle-Eastern district (Southern Michigan, Indiana, Ohio, West Virginia, Kentucky and Tennessee east of the Tennessee river, Alabama, Georgia and Florida)—Supt., Dr. J. M. Wheaton, Columbus, Ohio.

Mississippi valley—(Dakota, Minnesota, Wisconsin, Nebraska, Iowa, Illinois, Kansas, Missouri, Indian Territory, Arkansas, the small portions of Kentucky and Tennessee west of the Tennessee river, Texas, Louisiana, Mississippi)—Supt., Professor W. W. Cooke, Caddo, Indian Territory.

Rocky Mountain district (Idaho, Montana, Wyoming, Utah, Colorado, Arizona, New Mexico)—Supt., Dr. Edgar A. Mearns.

Pacific district (Washington, Oregon, California, Nevada)—Supt., L. Belding, Stockton, Cal.

The home of each observer is called a station, and is recorded by number upon the books of the committee. The committee particularly requests that all persons who read this circular, and are willing to aid in the work, will immediately communicate with the superintendents of their respective districts. Those residing in districts whose superintendents have not as yet been named, may address the chairman.

It is the duty of each superintendent to exert himself to the utmost to increase the number of observers in his district; to answer the questions they may put to him concerning the details of the work, etc.; to collect at frequent intervals the products of their labors; to ascertain from these data the whereabouts of certain species in winter and the times of leaving their winter homes; to determine, if possible, the number and extent of the chief avenues of migration within the limits of his district, and the average rate of speed at which the different species travel; to locate the breeding areas of the summer residents; and, finally, to submit the result of the season's work to the chairman of the committee. The chairman shall, in turn, arrange, condense and systematize the material received from the superintendents of the several districts, and shall present to the union the fruits of the joint labors of all the collaborators, together with any comments, deductions or generalizations he may have made upon the same.

INSTRUCTIONS TO COLLABORATORS.—The data collected may conveniently be arranged in three general classes: *a*. Ornithological phenomena; *b*. Meteorological phenomena; *c*. Contemporary and correlative phenomena.

(*a*) *Ornithological phenomena.*—Each observer is requested to prepare, at his earliest convenience, a complete list of the birds known to occur in the vicinity of his station, and to indicate (by the abbreviations enclosed in parenthesis) to which of the following five categories each species pertains :

1. *Permanent residents*, or those that are found regularly throughout the entire year (R).

2. *Winter visitants*, or those that occur only during the winter season, passing north in the spring (WV).

3. *Transient visitants*, or those that occur only during the migration in spring and fall (TV).

4. *Summer residents*, or those that are known to breed, but which depart southward before winter (SR).

5. *Accidental visitants*, or stragglers from remote districts (AV).

It is desirable also to indicate the relative abundance of the different species, the terms to be employed for this purpose being: *Abundant*, *common*, *tolerably common*, *rare*.

In many species the males arrive in advance of the females, hence it is important to note the sex of the first comers, and the date at which the opposite sex is first seen.

In recording arrivals and departures it is highly important to distinguish between the movements of the great bulk of the species and those of the forerunners or advance guard. For this purpose two dates should be recorded for the incoming, and two for the outgoing of every non-resident species, as follows :

1. The first appearance of the species (F).
2. The arrival of the bulk (BA).
3. The departure of the bulk (BD).
4. The last individual seen (L).

In addition to the above, which may be regarded as essential data, there are many other noteworthy details that bear more or less directly upon the complicated problems involved in the study of migration. Among such may be mentioned the bodily condition of the bird (whether fat or lean), the molt and the periods of song. The time of mating, when observed, should always be recorded.

(*b*) *Meteorological phenomena.*—Extended meteorological data are not required, though the observer would derive material assistance from a systematic weather record. The committee desires information upon :

1. The direction and force of the wind.
2. The direction, character and duration of storms.
3. The general conditions of the atmosphere, including rainfall.
4. The succession of marked warm and cold waves, including a record of all sudden changes of temperature.

(*c*) *Contemporary and correlative phenomena.*—The committee desires that the data under this head be as full and complete as possible, and requests exact information upon :

1. The date at which the first toad is seen.
2. The date at which the first frog is heard.
3. The date at which the first tree-toad or "peeper" is heard.
4. The dates at which certain mammals and reptiles enter upon and emerge from the state of hibernation.
5. The dates at which various insects are first seen.
6. The dates of the flowering of various plants.
7. The dates of the leafing and falling of the leaves of various trees and shrubs.
8. The dates of the breaking up and disappearance of the ice in rivers and lakes in spring, and of the freezing over of the same in the fall.

C. Hart Merriam,
Chairman of Committee on Migration,
Locust Grove, Lewis county, N. Y.

Color-Markings of Mammals.—Professor Eimer has continued his studies in regard to the color-markings of vertebrates. As the result of his observations he has laid down certain general

principles which he applies to the different groups, notably to the mammals.

The following general statements are elaborated: 1. That the color-markings of mammals may be reduced to longitudinal stripes, spots, and transverse stripes. 2. That the longitudinal stripes are the oldest form, and that the two follow in course. 3. That the primitive mammalian fauna was a longitudinally striped one. 4. That the males have been first to take on the new forms of marking, while the females hold longer to the older form. 5. That the effects of the law by which the development of the markings takes place from the posterior part of the body toward the anterior part are not so easily traced in mammals as in the case of other groups, such as the Saurians. 6. That in mammals the development of markings follows a regular course, that is, the longitudinal markings are followed by spots which, in turn, run together, and finally form the transverse or tiger stripes. 7. That the position of the smallest spot on a mammal is not accidental but due to the action of genetic and phylogenetic laws, from which it follows that markings are an available means for the determination of species. 8. That the regularity of the development of markings shows that they arise from constitutional causes.

The author takes the Viverridæ as the original types of the Carnivores, and believes that in the hyena, cats, dogs, bears, and weasels he can trace the form and position of markings possessed by the former. He acknowledges several difficulties, however, in the case of the leopard, jaguar, and other peculiarly spotted cats. He believes that the Ungulates follow the same law in regard to markings as the Carnivores.

Zoological Notes.—*Sponges.*—Mr. Carter (Ann. and Mag. Nat. Hist., Nov.) describes thirteen new species of sponges from various parts of the world.

Cœlenterates.—Dr. R. von Lendenfeld (Ann. and Mag. Nat. Hist., Oct., 1883) gives a valuable description of the guard-animals or nematophores of the Plumularia. He, with Hamann, restricts the term nematophore to the chitinous envelope of the guard-polyp which is truly a polyp the tentacles of which have become solid while the stomachal walls have grown together. In Plumularia these guard-polyps are well supplied with urticating capsules; some of those in Aglaophenia and Antennularia have adhesive cells, while some species of Aglaophenia have guard-animals or machopolyps supplied with both urticating capsules and adhesive cells. The writer agrees with Hamann in the belief that the urticating cells of Cœlenterates are not sense-cells, and states that "there exists a continuous connection between the nervous system and the plasma-mantle of the urticating capsule, which is ruptured by the pressure which the plasma-mantle exerts upon it." A preventive excitement may also issue from the nervous system, and paralyze the cnidocil. There is thus exhibited the

commencement of that reciprocal "reflex and preventive action to which modern psychology ascribes such great importance."——In a recent number of the Bulletins of the Museum of Comparative Zoölogy, Mr. J. W. Fewkes gives a list of thirty-five Medusæ found in Castle harbor, Bermudas, in May and June, 1882, describes the new species *Tamoya punctata* and *Oceanopsis bermudensis*, and gives notes on an unidentified Cladonema, an Ectopleura, and an Ephyra with sixteen tentacles.

Echinoderms.—Mr. F. J. Bell describes (Ann. and Mag. Nat. Hist., Dec.) *Asterias nautarum* from Ecuador, and *Cuicita acutispinosa* from Aneiteum, New Hebrides.

Vermes.—In the October issue of the Annals and Magazine of Natural History, Mr. F. E. Beddard has a note upon four species of earthworms from India viz., *Megascolex affinis*, *Perichæta armata*, *Perionyx macintoshii*, and *Typhæus orientalis*, the three last new. The anatomical characters of Typhæus are quite different from those of any other genus before described.

Mollusca.—The efforts of Mr. J. A. Ryder to artificially fertilize the ova of the American oyster have at last proved successful. The sexes of the oyster can be readily distinguished by the "drop test," that is, by the different behavior of a drop of milt, when placed in water, from that of a drop from the ovary of the female. The milt and ova were mixed in a dish, then poured into a pail of water, and then into a pond filled with sea water, which in its passage was compelled to pass through a filter of sand, so as to avoid all possibility of the entrance of germs from the outside. Forty-six days after the experiment was commenced spat from one-fourth to three-fourths of an inch in diameter was found in the pond.——Mr. R. E. C. Stearns, in a letter to the Fish Commission, states that *Glycimeris generosa*, of the western coast of the United States, attains a weight of sixteen pounds, and is probably the largest Saxicavid known, and, next to *Tridacna gigas*, the largest clam in the world.

Fishes.—M. G. Lunel (Ann. and Mag. Nat. Hist., October) describes a case of commensalism between *Caranx melampygus* C. and V., and the Medusa *Cambessa palmipes* Haeckel. The fish was fixed in the cavity formed by the junction of the four columns which unite the stomach of the jelly-fish to the umbrella. A comparison of the notes of various observers leads the writer to the conclusion that Medusæ do not eat small fishes, which their imperfect digestive apparatus could not digest; nor do small fishes eat Medusæ, as other writers have supposed, but that the young of certain fishes, the adults of which live at more or less considerable depths, come up to seek and reside with certain Medusæ.——Miss Rosa Smith (Proc. U. S. Nat. Mus.) has some interesting notes on twenty-five species of fishes taken at Todos Santos bay, Lower California.

Reptiles.—A (?) new species of lizard (*Sceleporus garmani*) is described by G. A. Boulenger, from Dakota, in the Proceedings of the Zoölogical Society of London.——In the Annals and Magazine of Natural History, G. A. Boulenger describes *Lipinia anolis*, from the Solomon islands; *Rhacophorus lateralis*, from Malabar; *Rappia burtonii*, from the Ancober river, Gold Coast; *Bufo andersonii*, from the north of Hindostan (Agra, Ajmere); *Hyla glandulosa*, from Guatemala; *H. macrops*, from Treasury island, Solomon group; *Hynobius lichenatus*, from Awomori, Japan; *Spelerpes peruvianus*, from Moyobamba, Peru; and *Cryptopsophis multipunctatus*, a new genus and species of Cæciliidæ, from the Seychelles. The genus differs from Dermophis in the absence of a second row of mandibular teeth. Fourteen genera of these snake-formed batrachians are now known.

The same naturalist also describes four forms of Lophognathus, two of which are new. *L. maculilabris* is from the Timor Laut islands, the others from Australia.

M. Boulenger also (Ann. and Mag. Nat. Hist., Nov.) notes that three genera of Geckoes (Eublepharis, Coleonyx, and Psilodactylus) have procœlian vertebræ and a single parietal bone, and thus lack the two chief characters on which the suborder Nyctisaura is founded. As the Varanidæ have the orbit incompletely surrounded, and the Helodermatidæ are without the parietal bar, these characters of the suborder also disappear. For these reasons M. Boulenger proposes to retain the group simply as a family under the old name of Geckotidæ, separating from it the three aberrant genera to form the family Eublepharidæ. Eublepharis is Indian, Coleonyx Central American, and Psilodactylus West African, yet all are closely allied both in structure and coloration, and all possess connivent movable eyelids.

Birds.—The Proceedings of the Zoölogical Society of London contains notes filling forty pages on birds collected in the Argentine Republic by E. W. White, edited by P. L. Sclater.——Mr. G. F. Gaumer spent three years exploring Yucatan; his ornithological discoveries are recorded by A. Boucard, with notes by O. Salvin, in the Proceedings of the Zoölogical Society of London. Gaumer's notes on the climate of Yucatan are of much interest, especially those relating to the senotes or underground caves of the country, which appear to be underground rivers.

Mammals.—In a paper on the natural position of the family Dipodidæ, in the Proceedings Zoöl. Soc. London, G. E. Dobson concludes that they are hystricine rodents having the bones of their hind limbs specially modified for leaping, and that their nearest existing allies are the family Chinchillidæ.——Professor R. Owen discusses in the same Proceedings the origin of the keelless sternum of Notornis, by "a combination of circumstances enforced, with operative conditions of organic vitality, first taught us by the immortal author of the Philosophie Zoölo-

gique." The same line of reasoning advanced by Owen applies to the origin of Aptornis and Dinornis.——The bottle-nosed whale is discussed by W. H. Flower and also by Captain Grey in the same journal, which also contains a figure of a new species of zebra (*Equus greyi*) recently described by A. Milne-Edwards, from equatorial Egypt.

PSYCHOLOGY.

THE DISEASES OF THE WILL.[1]—In the Humboldt Library Mr. Fitzgerald places before the public the results of the latest thought and labor of the scientific world, in a series of 8vo pamphlets costing fifteen cents apiece. This enterprize cannot be too highly commended from the standpoint of the public instructor and lover of knowledge. If the masses are ever to become acquainted with the laws of their being, such a publication as the Humboldt Library will prove a powerful agency in accomplishing the desirable result.

M. Ribot has the merit of stating, in clear and comprehensible language, the facts, doctrines, and hypotheses of modern metaphysics, so that the average reader may be easily introduced to perhaps the most important of all sciences. In this, and other essays on these subjects, M. Ribot pursues the inductive method, studying the mind as it is exhibited in the normal and abnormal types which are accessible everywhere. The important aid to be derived from pathology in mental science is well known. M. Ribot arranges the diseases of the will into several heads, viz: 1. lack of impulsion, as seen in irresolution; 2. excess of impulsion; 3, impairment of voluntary intelligence; 4, caprice; and 5, extinction of will. Under the last head he treats of ecstacy, nirvana, hypnotism, etc. The author shows the intermediary character of the will, that it is not only a cause, but also an effect, thus denying the ordinary form of so-called "freedom of the will." It is difficult to perceive the utility of the word will in this doctrine. As the outcome of a stimulus which has passed through more or less complex emotive or ratiocinative processes, action is only the movement of the last ball in a series in which the first one has been struck a blow. At best the word can only be used to represent a convenient fiction, supposing this doctrine to express all there is of will in the human mind.

A short paragraph expresses incidentally the author's views as to the origin of the mechanism whose action expresses human motives and human intelligence. I quote it as being in consonance with views often expressed by the present writer, but opposed to those held by many of the physiological metaphysicians of the present day: "The will has for its basis a legacy coming down from generations innumerable, and registered in

[1] The Diseases of the Will. By Th. Ribot. Humboldt Library, No. 52. Translated by J. Fitzgerald, A. M.

the organism, namely, primordial automatic activity, which is almost invariable, and quite unconscious, *although in the distant past it must have been accompanied by a rudiment of consciousness* which later faded away, in proportion as coördination, growing more perfect, became organic in the species," p. 38. The italics are our own.—*E. D. C.*

SAGACITY OF THE HORSE.—On my farm, one Sunday, the house was left in charge of one man, who sat in the porch reading. A mare, with her young foal, was grazing in the orchard near by. At length he saw the mare coming from a distant part of the orchard at full speed, making a loud outcry—a sort of unnatural whinney, but, as he says, more like a scream of distress than the natural voice of the horse. She came as near to the man as the fence would allow, and then turned back for a few rods, and then returned, all the while keeping up the unnatural outcry. So soon as he started to follow her she ran back in the direction of a morass or miry place which had been left unguarded and only stopped on its very brink. The man hastened to the spot with all speed, and found the colt mired in the soft mud and water. It was already dead.—*F. D. Caton.*

INDIVIDUAL IDIOSYNCRASY.—In an article contributed to *Mind* entitled "Idiosyncrasy," Mr. Grant Allen contends that the psychical individuality or native character of each of us is nothing but a sum of innumerable inherited tendencies combined in a peculiar way. He argues against Mr. Darwin's supposition of accidental or spontaneous variations of brain structure, on the ground that the intricate structural relations involved in any appreciable improvement of cerebral functions could never be produced in this "accidental" way. *The Academy*, in noticing the article, then goes on to say: "It may, however, occur to the reader that the essayist is here soaring into the regions of purely hypothetical physiology. For aught anybody knows, a difference in the quality of the brain substance might entail important psychical consequences; and it is hard to see why 'spontaneous variation' should be able to modify 'indefinitely' such qualities in a plant or animal as 'hardness of skin' or 'woodiness of tissue,' and not be adequate to bring about changes in the tissues of the nervous substance which may have well-marked psychical accompaniments. However this may be, Mr. Allen has to confess that we know nothing of the causes which determine in any case the selection, from among the apparently infinite number of ancestral tendencies somehow present in a latent form in the parents' nervous organization, of that particular mixture of elements which constitutes the original idiosyncrasy. And, this being so, it would seem that we must still have resort to the factor of 'accident.'"

DOMESTICATION OF ANIMALS.—Galton, in his "Inquiries into Human Faculty," remarks that the few animals we now possess

in a state of domestication were first reclaimed from wildness in prehistoric times. Our remote barbarian ancestors, he says, must be credited with having accomplished a very remarkable feat, which no subsequent generation has rivaled. The utmost that weof modern times have succeeded in doing is to improve the races of those animals that we received from our forefathers in an already domesticated condition. Galton throws out the hypothesis that only a few species of animals are fitted by their nature to become domestic, and that these were discovered long ago by the exercise of no higher intelligence than is to be found among barbarous tribes of the present day. The failure of civilized man to add to the number of domesticated species would on this supposition be due to the fact that all the suitable material whence domestic animals could be derived has been long since worked out. His argument is this: "All savages maintain pet animals, many tribes have sacred ones, and kings of ancient states have imported captive animals on a vast scale, for purposes of show, from neighboring countries. I infer that every animal of any pretensions has been tamed over and over again, and has had numerous opportunities of becoming domesticated. But the cases are rare in which these opportunities have led to any result. No animal is fitted for domestication unless it fulfills certain stringent conditions which I will endeavor to state and to discuss. My conclusion is that all domesticable animals of any note have long ago fallen under the yoke of man. In short, that the animal creation has been pretty thoroughly, though half unconsciously, explored by the every-day habits of rude races and simple civilizations." He then cites numerous cases in support of this view. He says, however, on p. 261, that "a young bison will try to dash out its brains against the tree to which it is tied, in terror and hatred of its captors." *Per contra*, we saw, in 1877, a young buffalo, perhaps a yearling, walking freely and like an ordinary heifer about one of the stations on the Kansas Pacific Railroad, going leisurely across the track before an approaching train; and it is well known that the buffalo can be tamed and hybridized with the domestic cattle. At the same time the village Indians of our continent have never domesticated the buffalo; it is not to be expected that our nomad, hunter Indians would have domesticated any animals except the horse and dog, and the Indian pony may yet be proved to have been a descendant of the American Quaternary horse, and the Indian dog an offshoot from the coyote.

ANTHROPOLOGY.[1]

WEATHER PROVERBS.—What archæology is to modern art and myths are to the higher religions, folk-lore is to sound philosophy: It is the fossiliferous stratum of human thought. Every

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

department of human activity has its folk-lore, as every phase of human life has its antiquities. The chief signal officer of the U. S. Army has done a lasting favor to anthropology by including among the "Signal Service Notes" Lieutenant H. H. C. Dunwoody's collection of weather proverbs. The critics have been making merry over this book, and asking General Hazen whether the prophecies concerning the weather have been taken from the pages commencing with:

> "When the ass begins to bray,
> Be sure we shall have rain that day?"

Of course not, for these proverbs were the guide-book of the critics' own kindred down to the establishment of the Weather Bureau. In this octavo volume of 148 pages, the work of over 300 collectors, we have about all that is worth gathering of weather lore. In the letter of transmittal, Lieutenant Dunwoody points out that many weather prognostics "express in a crude form the meteorological conditions likely to follow, and they have resulted from close observation. The increase of aqueous vapor in the atmosphere is indicated by its effect upon animal and vegetable organization, and possibly in the future the accurate observation of such phenomena may serve to supplement the present instrumental methods." Part I of Lieutenant Dunwoody's work opens with a discussion on weather prognostics and their reliability, reprinted from the *Quart. Journ. Meteorological Science*. Then follows the collection of proverbs etc., arranged in alphabetical order under some important word. Part II gives a compilation of instrumental and other local indications of approaching storms.

Canonicus Memorial.—On the 21st September the Rhode Island Historical Society erected a monument to the memory of Canonicus. A short time since some workmen in excavating for a sewer in Providence, brought to the surface, from the depth of eight feet, a large boulder of granite, and this has been erected in the "glen" of the North Burial-ground, to commemorate the life and virtues of the great sachem.

Aboriginal American Authors.—At the Congrès International des Américanistes, Dr. D. G. Brinton read a paper which has been enlarged and printed, since his return, in the form of an octavo volume bearing the following title: "Aboriginal American authors and their productions; especially those in the native languages. A chapter in the history of literature. By Daniel G. Brinton, A.M., M.D." Philadelphia, pp. 63, 8vo. Everything about this volume is attractive, and this remark applies not only to the mechanical execution but to the matter. Most people will be startled when they are told that there is any such thing as a book written by an Indian. We have all heard of fervid oratory, a love of story telling, a fondness for tropes, and language with

grammatic structure; but were they employed in creating a literature? Both in English and Spanish creditable literary work has been done by Indians, there is no *a priori* reason, therefore, against their producing better books in their own language.

Dr. Brinton, commencing with the far north, calls to mind:

Rink's "Legends and Tales of the Eskimo."
Pok's (a Greenlander) Travels in Europe.
Kaladlit Assilialit, &c. (see Field's Indian Bibliog., p. 199).
Walum Olum (History of the Delawares). Beach's Miscellany.
The Iroquois Book of Rites. No. II. Lib. Aborig. Am. Lit.
Story of Francois Kaondinoketo. Paris, 1877.
National Legend of the Chahta-Muskokee tribes. Histor. Mag., Feb., 1870.
Sequoyah's Alphabet.

Passing southward into Mexico, Central America and S. America, Dr. Brinton has found much more that is valuable, but the list is too long to be repeated here.

MR. BANCROFT'S LIBRARY.—The historian, Hubert H. Bancroft, is in Mexico, with three assistants, gathering material for his "History of the Pacific States." He has been received by the leading literary men, as well as by the President of the Republic and heads of departments, with marked consideration and respect. His works have been carefully reviewed by Altamirano, Chavero, Riva Palacio and others, and the government has opened the archives anew to his secretaries, besides presenting him with copies of all its publications. The addition to his library, from his journey to Mexico, will not be less than 6000 volumes, mostly rare books and manuscripts, once lodged in churches and convents.

The second volume of the History of the Pacific States has appeared, being also Vol. II of Central America. Vol. IV, the first on Mexico, was published some time since. Vol. III will conclude the history of Central America and bring the work down almost to our day. Mr. Bancroft should be rewarded in his great labor by the most liberal patronage.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.—It really looks as though the Washington Anthropological Society would live to maturity. Vol. II of its Transactions has just appeared, including the journal and papers from Feb. 7, 1882, to May 15, 1883. An introductory statement gives a brief history of the society and the method of its proceedings. The list of officers, of members, honorary, corresponding and active, follows. The list of papers is given below:

Limits of the Innuit tribes of the Pacific coast. By Ivan Petroff. [No abstract.] p. 3.
The classification of objects in the new National Museum in its relation to anthropology. By Professor G. Brown Goode. [Synopsis] p. 5.
The treatment of aborigines by colonists of higher races. By Professor Otis T. Mason. [Abstract.] p. 8.

The gentile system of the Iowas. By Rev. J. Owen Dorsey. [Abstract.] p. 10
Society as a domain of natural forces. By Lester F. Ward. [No abstract.] p. 11
Life in Zuñi. By Frank H. Cushing. [Abstract.] p. 14.
The turning point of modern sociological science. By Dr. J. C. Welling. p. 15.
The Carson footprints. By Dr. W. J. Hoffman. p. 34.
Anthropology at the American Association. By Professor Otis T. Mason. [No abstract.] p. 38.
Soapstone quarries and aboriginal tools for working soapstone. By J. D. McGuire. [Abstract.] p. 39.
Mound explorations in Southern Illinois. By Professor Cyrus Thomas. [Abstract.] p. 39.
Tattooing among civilized people. By Dr. Robert Fletcher. p. 40.
On the Hawaiians. By Capt. C. E. Dutton. [No abstract,] p. 68.
An inquiry into the origin of invention. By Col. F. A. Seely. p. 70.
Aleutian songs and traditions. By Ivan Petroff. [Abstract.] p. 90.
The Carson footprints. By G. K Gilbert. [Abstract.] p. 91.
Art in shell. By William H. Holmes. p. 94.
Cannibalism. By Dr. J. Hamilton Porter. [Abstract.] p. 119.
Stone implements from Ghazipur, India. By H. Rivett Carnac. [A letter.] p. 122.
Dakotan legends and myths. By Rev. J. Owen Dorsey. [Abstract.] p. 124.
On Sir Rawson Rawson's deductions. By Dr. Robert Fletcher. [Abstract.] p. 125.
Comparison of Eskimo pictographs with those of other American aborigines. By Dr. W. J. Hoffman. p. 128.
Illustrations of mythology from Slav and Magyar folk-lore. By Mr. Jeremiah Curtin. [Abstract.] p. 147.
The Shetimasha Indians of St. Mary's parish, Southern Louisiana. By Albert S. Gatschet. p. 148.
Mound distribution in the United States. By Professor Cyrus Thomas. [Abstract.] p. 159.
The use of the cross symbol by the ancient Americans. By William H. Holmes. p. 161.
Origin of the sexes. By Dr. Charles E. Hagner. [No abstract.] p. 172.
Annual address of the president, Major J. W. Powell. Delivered November 6, 1884. p. 176.

THE AMERICAN ANTIQUARIAN.—This useful journal closes its fifth volume with the October number. The contents are:

Native races of Colombia, fifth paper. By E. G. Barney.
Mexican antiquities. By L. P. Gratacap.
The gentile system of the Omahas. By Rev. J. Owen Dorsey.
Primitive Northwest. By C. W. Butterfield.
Babylonian and Assyrian art. By W. St. C. Boscawen.

The editor contributes a timely paper on mound explorations and an illustrated article on medicine men and animal symbols. The linguistic and ethnographic notes in this journal, edited by A. S. Gatschet, are among its most valuable contents. The proof-reading, especially of German and French publications, ought to be improved.

THE PALÆOLITHIC MAN'S BEADS.—Mr. W. G. Smith, in *Nature* Nov. 22, offers some statements confirmatory of the theory

Dr. Rigollot, Sir Charles Lyell and Mr. James Wyatt, that the well known foraminiferous fossil, *Coscinospora globularis* D'Orb., was used by Palæolithic man in making necklaces and other ornaments.

POPULATION OF CHINA.—Minister Young, of Peking, writes to the State Department, under date of May 22, 1883, respecting the population of China, as follows: "I have been informed indirectly, but from official sources, that the census of China, as taken last year for the purpose of taxation, shows a total population of 255,000,000. This does not include the Mongolian or other outlying dependencies of the empire, but only the eighteen provinces of China proper. Nor does it embrace the aboriginal tribes which exist in very considerable numbers in the Island of Formosa and the provinces of Kuangsi, Yunnan, Knei Chow and Szchuan. Making due allowance for understatements due to the purpose for which the census was taken, and for the aboriginal tribes mentioned above, and for the Mongolian dependencies, which are really an integral part of the empire, it is probable that the sum total of the population of China really exceeds 300,000,000. (Consular Reports, Aug., 1883.)

NOTICES or reviews of the following anthropological works have come to hand:

Swedish Society of Anthropology and Geography. Extract from Minutes 1881 to 1883. *Matériaux*, XVII, 380–390.

Anthropological Society of Paris. Meetings of July 20, October 5, 19, November 2, 16, December 7, 21, 1882; January 4, 18, February 1, 15, March 1, 15, 1883. *Matériaux*, XVII, 290–400.

The fibulæ of the age of bronze and of the first age of iron. By Oscar Montelius. *Matériaux*, &c., XVII, 427–434.

On the methods of rock-sculpture. By Hans Hildebrand. *Matériaux*, &c., XVII, 434.

Annual report of the professor of anthropology to the Museum of Natural History, Paris, 1883. [M. de Quatrefages.]

Studies upon the ethnology of India. By Paolo Mantegazza. Part I. General problems. The Hindoos. *Archiv. per l'Anthrop e la Etnol.*, Florence, Vol. XIII, pp. 177–241.

Ligurians and Celts in the Valley of the Po. By Professor G. Sergi. *Archiv. per l'Anthrop. e la Etnol.*, Florence, XIII, pp. 117–176.

The doctor among the Red-skins of French Guiana. By M. Boussenarol. *Rev. Scient.*, 24 Nov., 1883, p. 656.

Studies upon dreams. By M. Alix. *Rev. Scient.*, 3 Nov., 1883, p. 554.

Leech, Dr. M. L., History of the Grand Traverse region, including prehistoric days, early Indian history, Jesuit possessions, etc., to be published in 1884, in the *Grand Traverse Herald.*

The Lake-dwellers of Venezuela. (*Phrenol. Jour.*) *Kansas City Rev.*, VII, 486.

Inselgruppen in Oceanien. By A. Bastian. Berlin, Dümmlers. 3 tables, pp. 282, 8vo.

Contributions to the anthropological literature of America. By Dr. Emil Schmidt. Brochure, pp. 411–435 from *Archiv. für Anthropologie.*

Human footprints in a quarry at Carson, Nev. By Marquis de Nadaillac. *Matériaux*, &c, XVII, 313–321.

A hut of the stone age discovered at Schussenried (Wurtemburg). By Dr. V. Gross. *Matériaux*, XVII, 321–323.

The horse in prehistoric and historic times. By C. A. Pietrement. *Matériaux*, XVII, 323-336.

MICROSCOPY AND HISTOLOGY.[1]

PURE CARMINIC ACID FOR COLORING MICROSCOPICAL PREPARATIONS.[2]—Since Gerlach first called attention to carmin as a coloring matter for histological purposes, many methods of preparing the carmin solutions have been published, but, so far as I am aware, none which result in anything but mixtures of various carmin salts with undetermined and undesirable impurities, such as fatty matter, tyrosin, sugar, and salts of alkaline metals. Of course the coloration produced by these mixtures has been sometimes good, sometimes bad, and the solutions have easily spoiled or decomposed, while their preparation often required considerable time and trouble. Several years ago I studied carmin chiefly from a chemical standpoint, and since then I have often wondered why naturalists usually used carmin solutions in which water, with some caustic or destructive material added, was the principal solvent. Carmin of commerce, it is true, is not readily soluble, even in water, until ammonia, borax, or some other aid to solution is added; but carminic acid, the basis of the coloring matter of carmin, has long been stated in the leading chemical dictionaries and hand-books to be readily soluble in water and in alcohol. Watts (Dict. Chem., 1872, 1st suppl., p. 413) says of carminic acid: "This acid forms a purple mass, fusible and soluble in all proportions in water and in alcohol. Sulphuric and hydrochloric acid dissolve it without alteration. It bears a heat of 136° C. without decomposition."

Earlier still Watts (Dict. Chem., 1863, v. 1, p. 804) says: "The fine red pigment known in commerce as carmin is prepared by treating a solution of cochineal with cream of tartar, alum, or acid oxalate of potassium. The fatty and albuminous matters then coagulate and carry down the coloring matter with them. Now in preparing most carmin solutions this precipitation takes place, and the carmin, having greater cohesive (not chemical) affinity for impurities of animal origin than for alcohol, its solution is not readily accomplished by that medium, nor indeed by water. In preparing carmin solutions for histological purposes by some of the published recipes, more than one-half of the coloring matter of the carmin is lost in the refuse left upon the filter paper.

There are two ways commonly in use for preparing carminic acid, which term I here use as distinguished from "acid carmin" (the cochineal decoction for which Grenacher, Schweigger-Seidel

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] By Geo. Dimmock. Read at the New York meeting of the Society of Naturalists of the Eastern United States, 28th Dec., 1883.

and others have given recipes) and from carmin (the impure commercial powder). The first mode of preparation, the one which I followed in preparing the acid upon which I have experimented is that of Warren De la Rue. Watts, whom I quote because he gives clear directions (Dict. Chem., 1863, vol. 1, p. 804), gives De la Rue's method, as follows: "To separate it [carminic acid] cochineal is exhausted with boiling water; the extract is precipitated by subacetate of lead slightly acidulated, care being taken not to add the lead-solution in excess; the precipitate is washed with distilled water till the wash-water no longer gives a precipitate with a solution of mercuric chloride, then decomposed by sulphuretted hydrogen; the filtrate is evaporated to a syrupy consistence and dried over the water-bath; and the dark purple product thus obtained is treated with alcohol which extracts the carminic acid." The second mode of preparing carminic acid, that of Schaller, is given by Watts (Dict. Chem., 1872, 1st suppl., p. 413) as follows: "C. Schaller prepares this acid by precipitating the aqueous extract of cochineal with neutral lead acetate slightly acidulated with acetic acid; decomposing the washed precipitate with sulphuric acid; again precipitating the filtrate with lead-acetate, and decomposing the precipitate with sulphuric acid, avoiding an excess; then precipitating a third time, and decomposing the precipitate with hydrogen sulphide. The filtered solution is evaporated to dryness; the residue dissolved in absolute alcohol; the crystalline nodules of carminic acid obtained on leaving this solution to evaporate are freed from a yellow substance by washing with cold water, which dissolves only the carminic acid; and the residue left on evaporating the aqueous solution is recrystallized from absolute alcohol or from ether."

Schaller's mode of preparation gives purer carminic acid than De la Rue's, but either kind is sufficiently pure for histological purposes. The precipitation by lead acetate and the dissolving in alcohol free the carminic acid from animal impurities, and the consequence is a purer form of pigment than can be extracted by any process hitherto employed for the preparation of carmin for histological purposes. I will here add that carminic acid has been shown recently by Liebermann and Van Dorp to be related, through nitrococcusic acid, to trinitrocresol, which has been obtained from coal-tar cresol, thus showing that the coloring matter of cochineal contains methylated benzine-residues.

I do not know whether carminic acid, ready prepared, is obtainable. Any chemical student could easily prepare it by the processes given above.

It is unnecessary to explain to naturalists the advantages of alcoholic solutions of carmin over aqueous ones. The alcoholic solution colors preparations much quicker than the aqueous solution does; for coloring sections I employ a solution of 0.25 gram carminic acid to 100 grams of eighty per cent alcohol, and leave

sections in the solution from two to five minutes. A solution of equal carmin strength but in absolute alcohol can be employed; it has, however, no special advantages, since with the eighty per cent alcoholic solution the sections can be washed directly in absolute alcohol, and then put into oil of cloves or turpentin Coloring in the piece before sectioning never takes as long with alcoholic carminic acid as it does with ordinary carmin solutions, and if it did take long the strong alcohol would preserve the tissue from maceration. In coloring pieces of mollusca, or of other equally slimy animals, the slime should be removed beforehand, or the coloration will be unsatisfactory, because the slime congealing in the alcohol takes up the coloring matter, forming an almost impervious colored layer on the outside and leaving the inside of the piece nearly uncolored.

Some preparations colored in alcoholic carminic acid and then put up in glycerin lost their color in a few months, the color seeming to be entirely diffused in the glycerin, while similar preparations mounted in Canada balsam retained their color perfectly. I do not know if this fading would occur with preparations colored with alcoholic ammonic carminate, or even if this diffusion was not due to some impurity of the glycerin (of the purity of which I was doubtful); time to test this matter further failed.

An alcoholic ammonic carminate, or ammonia carmin, can be prepared, at a moment's notice, from alcoholic carminic acid, by adding ammonia, drop by drop, and stirring until the entire solution changes from its bright red to purple red. By this mode pure alcoholic ammonic carminate can be produced with no excess of ammonia, and at any time. As the carminic acid can be preserved dry without decomposition, and dissolves quickly in alcohol, one can carry the ingredients of a carmine solution in the vest pocket, without inconvenience.

In making and using alcoholic carminic acid pure alcohol and distilled water give the best results, because a portion of the carminic acid is converted to carminates by the salts of impure water. In making alcoholic ammonic carminate this precaution is not as necessary, because the color of the carminates produced by the impurities of the water is so nearly like that of ammonic carminate.

Alcoholic carminic acid may be used, as Grenacher's carmin solution is used, to color sections from which the coloration is to be afterwards partly extracted by very dilute hydrochloric acid, leaving nuclei red. Another way to use carmin solutions, which is especially applicable to alcoholic carminic acid, is to precipitate the carmin in the tissues by some salt, the carminate of the base of which gives a desired coloration. I have found, for example, that specimens hardened for a moment under the cover-glass with an alcoholic solution of corrosive sublimate (mercuric chloride) and, after washing with alcohol, colored in alcoholic

carminic acid, took a fine coloration of mercuric carminate. So, too, specimens colored in alcoholic carminic acid can be changed by a few moments' treatment with a *very dilute* alcoholic solution of lead-acetate or cobalt nitrate to a beautiful purple. With lead acetate used as above a double coloration is sometimes produced, but I have not examined sufficiently these colorations to accurately describe them. Cupric and other salts, used as above described, have not given me very favorable results. Sometimes salts in the tissues of the animals themselves change portions of the carminic acid to purple carminates, giving a double coloration without further treatment.

Picric acid added to alcoholic carminic acid *in extremely small quantities* (best in a dilute alcoholic solution, testing the solution on specimens after each addition) makes a double alcoholic coloring fluid (a so-called picro-carmin). I have been unable thus far to determine the proportion of picric acid required for this solution, having in every case added an excess. All different kinds of carmin solutions can be made from carminic acid with the advantage of having always uniform strength, of being definite mixtures, and of not spoiling as readily as those made directly from cochineal.

Incompatible reagents with carminic acid are, of course, all alkaline solutions and nearly all metallic salts; with ammonic carminate, are naturally all acids; with all carmine solutions, are bromine and chlorine.

I hope later to try some coloring experiments with coccinin, ruficoccin, carmin red, and ruficarmin, all of which are derived from carminic acid, and of possible value to the histologist.

Structure of Secretory Cells and their Changes in Secretion.—The histological structures of the various secretory cells have been described by different observers, as well as the changes undergone in them during the act of secretion. But these descriptions exhibit many discrepancies, which are largely due to the differences between the methods employed in studying the tissues. Mr. J. N. Langley, whose experience eminently qualifies him for such a task, undertakes to combine all that is true in our conceptions of the secretory cell. He says: "The glands of vertebrates in which I find that the secretory cells have fundamentally the same structure are—the serous and mucous salivary glands, and the similar glands of the mucous membrane of the mouth, nose, larynx, œsophagus, etc.; with a few exceptions, the 'chief' cells of mammalian gastric glands; the gastric glands of such birds, fishes, reptiles and amphibia as I have examined; the œsophageal glands of the frog; the pancreas; the liver. * * * * The secretory cells of all the glands in the list which I have given have the following common points of structure: The cell substance is composed of *(a)* a framework of living substance or protoplasm, connected at the

periphery with a thin continuous layer of modified protoplasm the framework in some cases has the form of a network of sma threads of equal size as described by Klein, in others of flattene bands. Further, the threads or bands may vary in size in di ferent parts of the cell, and the meshes in different parts of the cell may be of different size and shape. Within the meshes the framework are enclosed two chemical substances at leas viz., *(b)* a hyaline substance in contact with the framework, an of *(c)* spherical granules which are embedded in the hyaline sub stance. In the gland cells which secrete much organic matte the cell granules are conspicuous and fairly large. In the glan cells which secrete comparatively little organic matter the ce granules are, generally speaking, smaller and less distinct, the lower the mean percentage of organic matter is in the fluid secreted. The cell-granules are in nearly all cases mesostales *i. e.*, substances stored up in the cell and destined to give rise t the organic substances of the secretion. The granularity of a ce in the resting state thus depends upon its storage power. Gene ally speaking, the greater the storage power of a cell, the highe is the percentage of the organic substance in its secretions, bu this is not always the case, since it may happen that the rate o secretion of water may increase without any corresponding in crease in the rate of secretion of organic substance, and in conse quence the percentage of organic substance in the secretion ma be small; further, it is possible that under special circumstance a cell with small storage power might secrete a large quantity its stored-up material, and that a cell with a large storage pow might secrete a very small quantity of its stored-up materia the amount of water secreted by the two cells being approximate equal. In all these cells, during active secretion, the follow changes take place: The granules decrease in number, a usually, if not always, in size; the hyaline substance increase in amount; the network grows. The increase of the ne work is much less than that of the hyaline substanc Moreover, in the majority of cells the details of the change which take place are much the same. The hyaline substance i creases chiefly in the outer region of the cells, and the gran disappear from this region, so that an outer non-granular zon and an inner granular zone are formed. The network stretche throughout the cell in all cases. In the outer zone its meshes a filled with hyaline substance; in the inner zone its meshes a filled with granules and a small amount of hyaline substance The glands in which an outer non-granular zone is not formed during secretion are most of the gastric glands of the frog an toad, the gastric glands of the snake, and the liver of mammals * * * * * It is to be remembered that there is reason to be lieve that the three parts of the cell are continually being formed and changed into other substances. * * * The differences

shown by the different cells after the same treatment depends partly upon the different chemical characters of the framework, hyaline substance, and granules in the different cells, and partly upon the different arrangement of these constituents. * * * An obvious hypothesis is that the protoplasmic network forms the hyaline substance, and then out of this manufactures the granules, which are, as we know, converted during secretion into some one or more of the organic bodies of the fluid secreted. * * * The network appears to be the result of the two-fold tendency of the protoplasm to form fibrillæ, and to store up substances within its grasp; in most cases it is obviously not constant in form, but is continually altering the arrangement of its bars and the size of its meshes. This is especially distinct in mucous cells in which, during secretion, numerous fresh connecting fibrillæ are formed."—*Proc. Camb. Philos. Soc., Vol. v.*

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS.—This volume of 275 pages contains the proceedings of the sixth meeting of this active society, which was held at Chicago, Aug. 7–10, 1883. It has been edited by Dr. D. S. Kellicott, and has certainly been issued with promptness. The address of President McCalla was on the verification of microscopic observation. The specially microscopical articles were the following: College microscopical societies, by Sarah F. Whiting; the relation of aperture to amplification in the selection of a series of objectives, by Geo. E. Blackham; division of labor among microscopists, by J. M. Mansfield; photo-micrography with dry plates and lamp light, by W. H. Walmsley; the preparation and mounting of Foraminifera, with description of a new slide for opaque objects, by F. M. Hamlin; preparing and mounting bacteria, by T. J. Burrill; the microscope in the detection of lard adulterations, by W. T. Belfield; a new method of dry mounting, by A. H. Chester; a new form of microscope stand with concentric movements, by J. D. Cox; a critical study of the action of a diamond in ruling lines upon glass, by W. A. Rogers; cataloguing, labeling, and storing microscopical preparations, by S. H. Gage. There are also reports of the committee on eye-pieces, micrometry, centimeter scale A, 1882, a study of centimeter, marked A, prepared by the U. S. Bureau of Weights and Measures, by W. A. Rogers, and rules for the control of the standard micrometer.

"THE MICROSCOPICAL BULLETIN."—The first number of the new *Microscopical Bulletin*, to be published bi-monthly by James W. Queen & Co., Philadelphia, appeared in December. This publication is designed to answer the question, "What's new in the microscopical line?" The first number consists of eight double-column octavo pages, and contains the more interesting portions of Professor Duncan's address before the Roy. Mic. Soc., in 1882; a short essay on pathogenic bacteria, a description of a new slide-box, and other microscopic accessories.

SCIENTIFIC NEWS.

— It is proposed to collect the means to honor the memory of the late excellent naturalist and scholar, Dr. Hermann Müller, of Lippstadt, Germany, by supporting the widow of the deceased by creating a memorial, and by establishing a foundation, which shall bear the name of *Müller Foundation.* After the death of Professor Müller's widow, it is proposed that the interest of the memorial sum shall be given preferentially to some descendant of Professor Müller who shall devote himself to the study of natural philosophy, or else to some other needy and worthy student of that science who shall have been educated at the Public School of Lippstadt. The realization of these wishes will depend on the amount of funds to be collected, which shall be employed according to the final decision of a committee composed of the provisional one at Lippstadt and twice its number of donors from abroad. The committee purposes to send a biography with portrait of the late Müller to all those who have signified a real interest in the aforesaid foundation.

The editors of the AMERICAN NATURALIST very heartily endorse this appeal, and will take charge of and forward to the treasurer of the German committee any subscriptions they may receive from the American friends and correspondents of Hermann Müller.

— Professor Richard Owen, who is now eighty years old, has resigned the superintendency of the Natural History Collections of the British Museum at South Kensington. As a tribute to his genius and indefatigable scholarship, he has been made a K.C.B. Sir Richard Owen is still activein palæontological and morphological studies. Some idea of his industry may be gathered from the fact that he published, between 1830 and 1873, no fewer than 368 papers, the titles of which are given in the Royal Society's list, and since then he has contributed several others to the Transactions of the Royal and the Geological, Linnæan, and Zoölogical Societies, besides his Comparative Anatomy of Vertebrates, his Odontology, his Fossil Reptiles, and other works.

— The Bulletin of the Nuttall Ornithological Club is replaced by "*The Auk*, a Quarterly Journal of Ornithology." Why the two first words should be prefixed to what is otherwise a suitable title we are at a loss to understand. Of the hundreds of English names of birds, the one selected seems to our unaided mental vision to be the most unfortunate. A bi-syllabic title of some respectable bird still in the land of the living would evince better editorial taste. We question whether the bird's name did not have something to do with the extinction of the great auk. Barring its awkward, gawky cognomen, *The Auk* comes to us, however, as fat and juicy as ever was its prototype—and long may it "wobble"!

— M. Pasteur has shown that the bacillus of "rouget," as found in pigs, can be attenuated by passing it through rabbits. The inoculated rabbits are all rendered very ill or die, but pigs inoculated with the bacillus, after the virus has been passed through a series of rabbits, have "rouget" in a mild form, and enjoy immunity from further attacks. A series of inoculations carried through pigeons, on the other hand, increases the virulence of the disease when a pig is inoculated from the last of the pigeons.

— A change has recently been made in the constitution of the Royal Academy of the Lincei, in Rome, by which foreign members of all grades are admitted to an equal dignity with the regular members, and be participants in the same rights, and this was confirmed by the decree of King Humbert the First, on the 26th of July, 1883.—*F. V. H.*

— Mr. J. Starkie Gardner, of London, is preparing to bring with him, next summer, to this country a number of series of Eocene fossils of England. Each series will consist of twenty-five specimens, and each specimen will be seventy or eighty inches in superficial area, cleaned and hardened and in a separate case. Price £15.

— M. Cartailhac has communicated to the French Academy of Sciences a description of some old flint mines in Miocene strata, near Mur-de-Barrez, Aveyron, which appear to have been worked by Neolithic miners. This is stated to be the first discovery of prehistoric mines in France.—*English Mechanic.*

— We received, December 20, 1883, a general geological map of the area explored and mapped by Dr. F. V. Hayden and the surveys under his charge from 1869 to 1880. One can obtain a clear idea of the relations of the formations of an area of over 500,000 square miles in extent.

— Of the fourteen circumpolar expeditions eleven have safely returned. The Russian at the mouth of the Lena, and the Finnish at Sodankyla, will be continued for another winter, while the fate of the American expedition to Lady Franklin bay is unknown.

— We regret to notice the stoppage of Dr. C. F. Lutken's popular Danish Journal of Science, the *Naturhistorisk Tidsskrift*, which has been successfully conducted and well patronized in Denmark for nearly twenty years.

— The excellent German scientific monthly, *Cosmos*, begins January, 1884, in a new form and cover. It proposes more especially than heretofore to be an exponent of the doctrines of development.

— Mr. Romyn Hitchcock announces that the American Monthly Microscopical Journal, for 1884, will be published hereafter by himself, at Washington, D. C. (P. O. box 630.)

—Professor Flower is spoken of as the successor of Professor Owen as director of the South Kensington Museum, London.

— Fossil fishes of the Green River shales may be had from S. H. Sommers, St. Joseph, Mo.

— Brig.-Gen. Andrew A. Humphreys, U. S. A., retired, died suddenly at Washington, D. C., Dec. 28, from an attack of *angina pectoris*. The deceased had a brilliant record, both military and civil. At the close of the war he was assigned to duty as chief of engineers, which office he filled until June 30, 1879, when he was retired at his request. He was a member of various American and foreign societies. He will be remembered for his work in connection with Gen. Abbot in the physics and hydrography of the Mississippi river. He was also chief of the surveys for the Pacific railroad, finishing his report in 1861.

— The death is announced of Professor Sven Nilson, the well-known Swedish naturalist, at the ripe age of ninety-seven. He was born at Landskrona, in March, 1787, and so long ago as 1811 obtained the degree of Ph. D. from the University of Lund. His magnum opus is the work on the Scandinavian fauna which occupied him for more than thirty-three years. His last important work was The Primitive Inhabitants of Scandinavia.

— Professor Wm. Denton, of Wellesley, Mass., recently died of fever in New Guinea. His two sons, who were with him, have recently returned to this country, bringing with them a large collection of birds. They state that the natives they met with are friendly.

—As we go to press we hear of the death of Professor Arnold Guyot of Princeton, the well known geographer and geologist.

— The death is also announced of Professor Ercolani, of Bologna.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Philosophical Society, April 20, 1883.—Mr. E. W. Claypole read a paper by Professor H. S. Williams, entitled "On a Crinoid with movable spines." The same gentleman also read a paper making a correction of the geological map of Perry county, south of New Bloomfield. At this spot the Lower Devonian is faulted down 3500 feet against the Upper Helderberg.

May 18.—Mr. E. W. Claypole communicated a note "On a relic of the native flora of Pennsylvania, surviving in Perry

county," with specimens of *Vaccinium brachycerum* Mich. (*Gaylussaccia brachycera* Gray).

June 16.—Professor Cope presented the following papers from Dr. A. S. Packard: On the morphology of the Myriopoda; A revision of the Lysiopetalidæ, a family of Chilognath Myriopoda, with a notice of the genus Cambala. Mr. Grote communicated a paper upon the Noctuidæ. Twenty-four sub-family groups are here proposed and the structure discussed. About half-a-dozen forms of this family were known in 1859, between which date and 1883 Mr. Grote himself described about 100 genera and 1000 species, so that the total number of species known is now about 1700. The outlines of Mr. Grote's theory of geographical distribution and migration are also given in this paper.

Aug. 17.—A paper upon a large crustacean from the Catskill group of Pennsylvania, by Mr. E. W. Claypole, with a note "On the genus Renssalaeria in the Hamilton group of Perry county, Pennsylvania," and another upon "The equivalent of the New York Portage group in Perry county, Pennsylvania," both by the same author, were read. Specimens of rye, barley, and wheat grains that had sprouted in ice were exhibited, with a letter from Mr. J. Lesley.

Oct. 5.—The Secretary read an article of Professor D. Kirkwood upon the "Zone of Asteroids and the rings of Saturn."

Oct 19.—An annotated translation of the Ramirez MS., giving the history of the Mexicans from their paintings, was communicated by Mr. H. Phillips, Jr. A memoir by Dr. J. C. Branner, upon the course and growth of the fibro-vascular bundles in palms, was also read. Dr. Frazer exhibited a map of Radnor township and the surrounding district, showing the belt of syenite gneiss which runs east and west from Radnor to Wayne stations. Dr. Frazer also discussed the stratigraphical relationships of the serpentine belt south of it. He considered the magnesian beds as original parts of the series, instead of exogenous, as maintained by Mr. Rand.

Nov. 16.—Professor Cope described the formations of New Mexico, the fossils of which he had been studying in his recent journey.

Dec. 7.—Mr. Lilly's section of 1855 feet of Devonian rocks, visible in Gulf Brook gorge, at Leroy, Pennsylvania, was presented. Professor Houston described Mr. P. B. Delancey's method of obtaining perfect self-adjustable synchronism in his synchronous-multiplex telegraph. Professor Cope communicated papers entitled: "On the distribution of the Loup Fork formation in New Mexico;" "Second addition to the knowledge of the Fauna of the Puerco epoch;" and "On the trituberculate form of molar tooth in the Mammalia."

Dec. 21.—Professor Rothrock read a paper entitled "The microscopical examination of timber with regard to its strength,"

by F. M. Day. Dr. H. Allen read a paper "On a case of human congenital malformation," and exhibited photographs.

Jan. 4, 1884.—Professor Lesley presented a note upon the possible original meanings of the animal ideographs of the god Set.

PROCEEDINGS OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Nov. 8.—Dr. Sharp called attention to the presence of retinal cells upon the siphon of Solenensis. His attention was first drawn to the matter by observing that these mollusks retracted the siphon when the shadow of his hand passed over the water of the dish they were contained in. Mr. T. Meehan gave an account of his visit to Alaska. The Davidson glacier is retreating, but the great Muir glacier, which has a frontage of two miles a thickness of 960 feet, and is said to be 400 miles long, still pours its icebergs into the ocean. The region is singularly favorable to vegetation, and the forests, though of few species, are often so dense as to make travel impossible. The trunks frequently touch, in which case their timber is of little value.

Nov. 15.—Dr. Randolph called attention to the structure of the wheat grain. His methods had rendered apparent the presence of gluten in the body of the cell, while the so-called gluten cells of the cortex do not respond to any artificial digestion, and seem to have but little nutritive value.

Professor Heilprin said that a small collection of fossils sent by Professor Cope from Laredo, Texas, proved that the Claiborne or Parisian formation extended south to that point. There is little doubt that it penetrates some distance into Mexico. There must, at some point near this locality, be a contact with the brackish water or terrestrial strata, of as yet undetermined age, to be found further inland.

Nov. 21.—Dr. Sharp called attention to Professor Semper's method of preparing dried specimens of soft animals, and exhibited some beautiful examples.

Dr. Leidy described an older method in which hot tallow was injected, aud afterwards dissolved out with turpentine. Professor Cope spoke of the cretaceous formations, Nos. 4, 5 and 6, in the central part of Dakota, and of extensive buttes lying on the plains. These buttes contained fossils characteristic of the White River Miocene beds.

Dr. Hayden said that the fresh-water lake indicated by these deposits must have extended over 100,000 to 150,000 sq. miles.

Rev. Dr. McCook stated that the occident ant (*Pogonomyrmex occidentalis*) was in Dakota confined to the bottom lands along the Missouri river; it does not stretch eastward of that river in the state of that name, and is absent in Eastern Nebraska, though it abounds in the west of that State, and in Kansas does not occur further east than Brookville. The dèbris collected from the nests

contained some undeveloped pods of *Dalea alopecuroides*, the refuse of the harvesting of these creatures.

A paper entitled "Notes on American Fishes Preserved in the Museums of Berlin, London, Paris and Copenhagen," by D. S. Jordan, was presented for publication, as also one on "Staining with Hæmatoxylon," by Dr. C. L. Mitchell.

Nov. 29.—Rev. Dr. McCook exhibited and described the tent and egg-nest of *Attus opifex*, a Californian saltigrade spider. Dr. McCook also reported the discovery on the Wissahickon of *Psocus expunctatus*, a web-spinning neuropterous insect, not before known to occur in this country. Dr. Horn exhibited specimens of the curious beetle *Platypsylla castoris*, parasitic upon the beaver. These specimens came from European beavers living at the mouth of the Rhone, but the species was first described from examples taken from an American beaver living at Amsterdam. Mr. Cresson described some Aztec bells, considered the probable mode of their manufacture, and compared them with Peruvian, Assyrian and Egyptian forms.

Dec. 6.—Professor Lewis exhibited some gold nuggets from Montgomery county, N. C. Professor Cope placed on record a new genus of mammals supposed to be Lemuroid from the Puerco Eocene. The typical species is *Indrodon malare*.

December 12.—Rev. Dr. McCook described the manner in which the queen ant starts a formicary, as illustrated by the wingless queens of *Camponotus pennsylvanicus*. These had walled themselves in with small particles of bark. Professor Heilprin gave the results of his studies upon the tertiary and cretaceous of the Atlantic and Southern States. The three lowest Cretaceous deposits belong to the Senonian, and the upper one to the Mæstricht group. The boundary of the tertiary was traced through Virginia and the Carolinas. Patches of eocene occur along the rivers of North and South Carolina. Professor Cope exhibited the skull of *Aphelops fossiger* from the Loup Fork strata of Sand creek, an affluent of the San Francisco river, New Mexico. Photographs of an Aphelops indistinguishable from this species indicated the existence of the Loup Fork beds near the City of Mexico. Mr. Wortman referred to similar remains in Florida, indicating the presence of the same beds. Professor Lewis announced that the angles of a mineral described by him at a previous meeting as new, were identical with those of Sarcolite. The large size of the crystals found in Canada is remarkable. Dr. Leidy stated that he had learned that the supposed fresh-water cephalobranch worm Manayunkia, recently described by him, was found in a mill-pond some times overflowed by the ocean, so that, after all, the species may be marine. Dr. A. J. Parker called attention to what may prove a new method of reproduction observed by him in *Amphileptis fasciola*. The lengthened extremity of one of these infusorians broke up into little masses of protoplasm having

amœboid movements, although the cilia of the creature continued active. A bud then appeared in the ectosarc, which was followed by the endosarc, and grew until the original form was attained. Rev. Dr. McCook spoke of the architecture of *Formica rufa*, as displayed in Dakota. This ant is European, but occurs also on the plains, even to the elevation of Leadville. It is not found on the Atlantic sea-board.

Biological Society of Washington.—The fourth anniversary meeting was held on Friday evening, January 25th. The President, Professor Charles A. White, delivered the annual address upon: "Certain phases in the geological history of the North American continent, biologically considered."

New York Academy of Sciences, Jan. 7.—The paper of the evening was: Notes and criticisms on Mr. Grant Allen's theory of the origin of leaf-forms (illustrated with specimens), by Dr. N. L. Britton.

Jan 14.—The following papers were read: The erosive power of glacier ice, and its influence on the topography of North America, by Dr. John S. Newberry; "Field-work in local mineralogy, by Mr. B. B. Chamberlin.

Jan. 21.—The following paper was read: Methods of animal self-defence (illustrated with lantern), by Professor H. L. Fairchild.

Jan. 28.—Professor J. W. Powell, of Washington, D. C., delivered a lecture on: The mythology of the Indians of the Sacramento valley.

American Geographical Society, Jan. 24.—The lecture of the evening was on the exploration of Petra-Arabia, by Edward L. Wilson, Ph.D., illustrated with views.

Boston Society of Natural History, Jan. 16.—Mr. S. Garman spoke on the "sea-serpent," and showed a remarkable new Selachian. Mr. W. O. Crosby discussed the relation of the slates and conglomerates of the Boston basin.

Appalachian Mountain Club, Jan. 9.—Annual meeting. The reports of the Secretaries and the Treasurer were presented and the annual election of officers held. Mr. Elizur Wright read a paper on "The sanitary effect of forests." Rev. William C. Winslow read a paper on "Mount Zion, to-day."

Jan. 18.—Special meeting. Mr. Fred. A. Ober read a paper on "Mexico," including an ascent of Popocatapetl; a large number of lantern views being shown.

Natural Science Association of Staten Island, Jan. 12.—One new member was elected and other business transacted. Mr. C. W. Leng then read a paper on the Cicindelidæ of Staten Island. Remarks were made by Mr. Sechusen on a very interesting series of precious stones, their particular characters, and the localities from which they came. He presented the collection to the society.

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THE EXHALATION OF OZONE BY FLOWERING PLANTS.

BY J. M. ANDERS, M.D., PH.D.

THAN ozone there is, perhaps, no more highly remarkable and perplexing substance. Nevertheless there is no substance more important to the sanitarian for study and consideration, since it has undoubted hygienic bearings, some of which are now quite well understood. There is no question but that through its oxydizing properties it is the greatest natural purifier of the atmosphere.

It is doubtless nature's means of ridding our atmosphere of organic impurities, and disease germs, which cause, as is well known, manifold forms of suffering, and render the air unfit for breathing purposes.

We have little certain knowledge of its real nature and many of its properties; and leaving the solution of these more puzzling questions to the expert chemist, I purpose to adduce evidence with a view of establishing a newly-discovered source in nature of this important substance.

Ozone can be artificially formed in various ways, to wit: by passing electric discharges through pure oxygen; by the electrolytic decomposition of water; by suspending a stick of phosphorus in a bottle filled with moist air, and in other ways. It is present in the atmosphere, but not universally. Fresh, pure atmosphere generally contains ozone, while it is absent from the close air of cities and occupied dwellings, for the reason that in the latter places it is consumed in oxydizing and destroying organic impurities. For a like reason it is frequently found in the air to the windward of a city, but rarely or never to the leeward.

In my readings, while preparing earlier memoirs on some plan functions, I would not infrequently meet with statements to t effect that some sort of relationship exists between vegeta and particularly forest growth, and the ozonic condition of t atmosphere. Thus, as stated in a former paper, a Dr. Schr maintains that the emanations from pine forests actively con the oxygen of the air into ozone, but upon what basis of truth any, the statement rests, I have not learned. A. Naquet s "Ozone exists in woods and fields and wherever there is ac vegetation." It is evident that assertions of a general charac like the above, without experimental proof, are of no real sc tific value. On the other hand, the solution of so importa question as whether plants generate or convert the oxygen of t air into ozone, could not fail to be hailed as a noteworthy adva in scientific knowledge.

For more than a year past the writer, while engaged in t active practice of his profession, has devoted his interva leisure to an experimental investigation of the subject. Pre nary to giving in detail the results of these experiments, thought proper to speak of the various tests for the detect ozone, and to point out the relative merits of the same. As dicative of the difficulties of making such tests, numerous o scopes have from time to time been devised, most of which h proved highly unsatisfactory.

Dr. A. R. Leeds, of Stevens Institute of Technology, has m an investigation into the relative merits of some half dozen ing tests for ozone (*Chem. News* for May, 1878). Without a detailed account of his observations, it will suffice our p to state a few of his conclusions. The Schoenbein or oxy starch test was found to be most sensitive. It may be here that this test was used in all my observations. Of the gua test, which was also employed in our experiments, Dr remarks, "Guaiacum papers were only moderately sensitive quiring speedily, when dry, a faint blue color, and when m tened occupying a position midway between the ozonoscopes sensitive, and those least so to the influence of ozone."

In the National Board of Health Bulletin (for March, 18 Dr. J. H. Long, under the auspices of the American Medica sociation, records the results of ozone observations made in ent places throughout the United States, by a number of g

men who kindly coöperated with him. In these investigations three kinds of tests were employed, to wit: Schoenbein paper, paper impregnated with tincture of guaiacum, and paper impregnated with solution of thallous hydrate. The doctor gives the methods of preparing these different papers. The Schoenbein is made according to the following formula: Potassium iodide 5 parts, starch 50 parts and water 1000 parts. The starch and iodide are rubbed with a small amount of water until a milky homogeneous fluid is produced, and then the rest of the water is added and the whole boiled for some time with constant stirring. The freshly prepared paste is spread on strips of filter paper, which are afterwards dried in a close room. The filter paper used is the best Swedish (Munktells). The guaiacum is made from a carefully prepared tincture containing 8 per cent of resin and 92 per cent of alcohol. When exposed to artificially prepared ozone this paper turns greenish-blue and finally a bright blue, while the Schoenbein turns quite blue. The papers employed in the present researches were very kindly prepared for me by Professor Henry Leffman after the above formulæ, and they gave excellent reactions both in the hands of the professor and in my own hands, when exposed to ozone artificially prepared. The iodized starch, or Schoenbein, being universally acknowledged to be the most sensitive, as well as giving the most reliable results, the reactions obtained by this test were considered of paramount importance and value. There are, however, sometimes other bodies present in the atmosphere which have the power of decomposing iodide of potassium, and hence give a blue reaction as well as ozone, to wit, peroxide of hydrogen, the oxides of nitrogen and ammonia. The latter substance can be detected by suspending a piece of red litmus near to the test papers, the effect being to turn the paper blue. The presence of the nitrous oxides can also be readily demonstrated. How to avoid mistaking the reaction of peroxide of hydrogen for ozone may prove difficult, since the two substances appear to have many properties in common. Indeed, it has been a disputed question among chemists whether it is possible to distinguish between them by any known tests. Professor A. R. Leeds (*Chem. News* for April 9, 1880) claims to be able to recognize each by its own properties. He continues, "The most striking property of ozone is its smell. This smell, so far as long continued familiarity with it enables me

to judge, whether the ozone is derived from the silent discharge of pure and dry oxygen, or accompanies the electrolysis of water (and the smell is identical), is possessed by ozone only." The odor is not peculiar to peroxide of hydrogen, for the same author says of this substance, "The solution which I have prepared at different times myself, carbonic acid being employed to decompose barium peroxide, have not evolved any odor that I was able to recognize or perceive. Ozone is only slightly soluble in water and is readily expelled on heating, while hydrogen peroxide is miscible, and solutions containing one per cent of peroxide of hydrogen may be concentrated by evaporation on the water bath until a higher degree of concentration is reached without great loss of peroxide."[1]

The question, can ozone and peroxide of hydrogen coëxist in the same atmosphere? has also been oppositely discussed by chemists. Professor McLeod, as the result of his investigations (*Chem. News*, Vol. XL, p. 307), concluded that these two bodies decompose one another. From this fact he further argues that it is extremely improbable that ozone and peroxide of hydrogen are both formed during the slow oxydation of phosphorus. On the other hand Schöne, by an elaborate series of experiments (quoted by Leeds) shows that when strongly oxydized oxygen, containing 5.2 volumes per cent of ozone, is agitated with an hydrogen peroxide solution containing 0.4 per cent of the peroxide, or three or four times as much as is necessary to destroy all the ozone, it is only after the lapse of half an hour that as much as half of the ozone is destroyed. Professor Leeds, in the article already referred to, comes to the rescue of Schöne, and very conclusively shows that not only ozone but also peroxide of hydrogen are formed during the slow oxydation of phosphorus, and that these two substances can and frequently do coëxist, the absolute quantity depending upon the temperature, the length of time they remain in contact with one another, etc., though it is true that a slow, mutual decomposition takes place when together. According to all the best authorities, peroxide of hydrogen decomposes at a temperature of about 70° Fahr., while to destroy ozone requires a temperature of about 200° Fahr. The importance of this fact cannot be overrated, as it has a great bearing upon the results of the present experiments.

[1] See also Schöne, Ann. der Chem., 196, p. 60, and Davis, *Chem. News*, XXIV, p. 221.

In the case of the guaiacum test there are so many interfering conditions as to render it nearly valueless. Thus it will not only react in the presence of peroxide of hydrogen and the oxides of nitrogen, but even the oxygen of the atmosphere is said to impart to it a tint hard to distinguish from the coloration due to ozone.

The color scales were not used in these researches, as they are very difficult to obtain and, furthermore, the object here was not so much to ascertain the degree of coloring of the test papers as the single important fact whether plants have the power of generating ozone.

In noting the results obtained, the terms "marked," "slight" and "very slight" are used to express, in a general way, the extent of blue coloration. This plan is deemed preferable for the reason that the tints, in most instances, were not very striking.

My first observations were conducted in Horticultural Hall, Fairmount Park, Philadelphia. It was thought that a careful testing of the air of this hall, filled as it is with a profusion of plants, mostly of the foliage varieties, would give results sufficiently striking to be of value in clearing up the subject. In this, however, I was measurably disappointed, as will be seen hereafter. The hall has several compartments. The so-called main hall, of about the following dimensions: 220 feet in length, 100 feet in width and, the dome-like roof being of glass in the center, 65 feet high. The room is filled with a variety of species of palms, bananas, monesteras, colocasias, caladiums, ferns, *Ficus elastica*, bamboo canes, Australian and New Zealand pines and numbers of smaller foliage plants. Average temperature of the hall during the time of experiments, 70° Fahr.

On either side of the main hall are several smaller ones in which the air was likewise tested, known under the names fern house, forcing house, temperate house, propagating house and economic house. The dimensions of these rooms are, length 100 feet, width 30 feet, ceiling, curvilinear and of glass, 20 feet in height. The temperate house contained half hardy plants, as the orange, lemon, hibiscus, and a number of azalias in bloom. The forcing house contained bedding plants, geranium, colius and achyranthes, but few blooming, mostly cuttings. Economic house contained pitcher plants, tea, coffee, chocolate, sugar, yapas, cinchona and aromatic plants. Propagating house is located outside of the main building, and contained geraniums in bloom. The fern house was well stocked with ferns.

The average temperature of these apartments was as follows: Economic house 80°, temperate house 55°, fern house 65°, forcing house 75° Fahr.

The first experiments were commenced Oct. 14, 1882, and continued till the end of November. The atmosphere of the main hall was tested on twenty-five days during this period, the Schoenbein giving negative results except on Nov. 29th and 30th, when this paper showed a slight blue tint. The papers were placed on the branches of the highest plants, moistened both when they were suspended and after being taken down, and the duration of the experiments varied from four to twenty-four hours.

The guaiacum test paper showed a very slight reaction for about one-half of these observations, but unfortunately this test could not be relied upon, while the results with the Schoenbein were too meager on which to base conclusions. A few tests were made during this series simultaneously in the forcing and fern houses with negative results. It should be stated that these experiments were being conducted at a time when numerous visitors were daily attracted to the hall by the indescribable beauty of the plants, and hence it was thought not unreasonable to suppose that any ozone which might have been generated by the plants was consumed in oxydizing the organic matter given off to the air by the visitors, for it should be remembered that, as Pettenkofer has pointed out, ozone is never detectable in the atmosphere of occupied dwellings. Though these experiments were barren of results, when the above circumstances are taken into account they were not much to be wondered at.

The next series of observations began in the latter part of February, and were continued through the months of March and April of the past year. During the month of February there was only an occasional visitor admitted, in March there were likewise very few, while in April the number was considerably greater though not by any means numerous. These experiments yielded results somewhat more encouraging. The atmosphere on the exterior was simultaneously tested for the sake of comparison of the two situations. The observations were taken for fourteen days in the main hall, Schoenbein papers being used, and five of these gave "very slight" reactions, while the outer air gave during the same time six "very slight" reactions and one "slight." Twenty-four tests of the air in the temperate house with the

Schoenbein gave only three "very slight" reactions. During these observations the outer air was tested twelve times, with but two "slight" reactions, and the air of the propagating house for the remaining days in place of the outer air, which gave two "very slight" reactions. The air of the propagating house was next compared with the external air. For thirteen days in the former situation the Schoenbein paper gave "very slight" reactions in four instances, while the latter (outer air) gave "very slight" indications of ozone in two instances. It will be observed that here the result was better in the propagating house than in the open air, which was, to say the least, quite suggestive. In all the preceding experiments of this series there was a striking similarity in the two situations, and the outer air giving somewhat the better results. The air of the fern house, as well as economic house, were also given a few trials and compared with the outer air, but the results were negative throughout. During all of the outdoor observations the guaiacum paper gave slight indications of ozone in more than half of the experiments, and striking in four cases. The results with this paper for corresponding days indoors were almost identical, with the degree of coloring in a few instances in favor of the outside. The propagating house yielded the best indoor results with the guaiacum paper, as did the Schoenbein, while the temperate house gave almost equally good results with the guaiacum paper as in the propagating house. This was not the case, it will be remembered, with the Schoenbein. The duration of the individual experiments varied from six to sixteen hours, the average duration being about ten hours.

The question here arises, were the reactions obtained by the indoor tests due to ozone emitted from the plants or to the circulation of the outer air through these apartments. There is constantly more or less interchange of air between the exterior and interior of the building, due to the numerous interstices between the panes of glass and the frequent opening and closing of the doors. It must also be observed that all these apartments are heated (and artificial heat was necessary during all these investigations) by numerous hot water pipes placed directly under and parallel with a grated floor from which warm air rises and ascends through the building. The idea that the external conditions might have affected the results on the inside is doubtless still further strengthened by the fact that most of the results obtained

were, as already stated, nearly identical in the two situations, with a preponderance of coloring in favor of the outside. I was thus forced, though reluctantly, to dismiss all the experiments thus far made as having yielded doubtful results, excepting those made in the propagating house, of which it will be necessary to speak further.[1]

How can we account for the results in this situation differing from those of the other rooms? I was unable at that time to find any good reason, the conditions appearing to be about the same. Subsequent experimentation, however, threw new light upon this vexed question. It will be only necessary here to state, what I trust will be evident to the mind of the reader later on, that the somewhat more striking results in this house must have been due to the fact that it was well stocked with flowering geraniums.

(To be continued.)

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THE CREODONTA.

BY E. D. COPE.

(Continued from the March number, p. 267.)

Hyænodontidæ.

IN this family the anterior cusp of the inferior true molars is so developed as to form, with the median cusp, a true sectorial blade. The posterior cusp is rudimental, and in the last inferior molar wanting. There is no internal tubercle. In the superior molars, on the contrary, the anterior basal cusp has disappeared, and the posterior one is developed behind the middle one, like a blade. The superior molars, like the inferior, have no internal lobe.

Professor W. B. Scott has studied the posterior limb and the brain-case of a species of Hyænodon, which he describes as follows. I quote from the advance sheets of his paper on this subject, which he has kindly permitted me to use:

"The hind limb is in essentials very like that of Mesonyx of the Bridger Eocene; the femur has a decided third trochanter. The tibia is much like that of Mesonyx, and its distal end is characteristically Creodont in having its astragalus face almost

[1] My acknowledgments are due Mr. Menje for valuable assistance while collecting these observations.

flat, with only a very slight median ridge for the groove of the astragalus. The internal malleolus is very large.

"The astragalus is but slightly concave from side to side, much less so than in Mesonyx.

"The foot is plantigrade, and the entire length of the calcaneum rested on the ground. Five well-developed digits were present, terminating in short and stout compressed claws; very different from the peculiar depressed ungual phalanges of Mesonyx; otherwise the resemblance of the foot as a whole to that of Mesonyx is very striking.

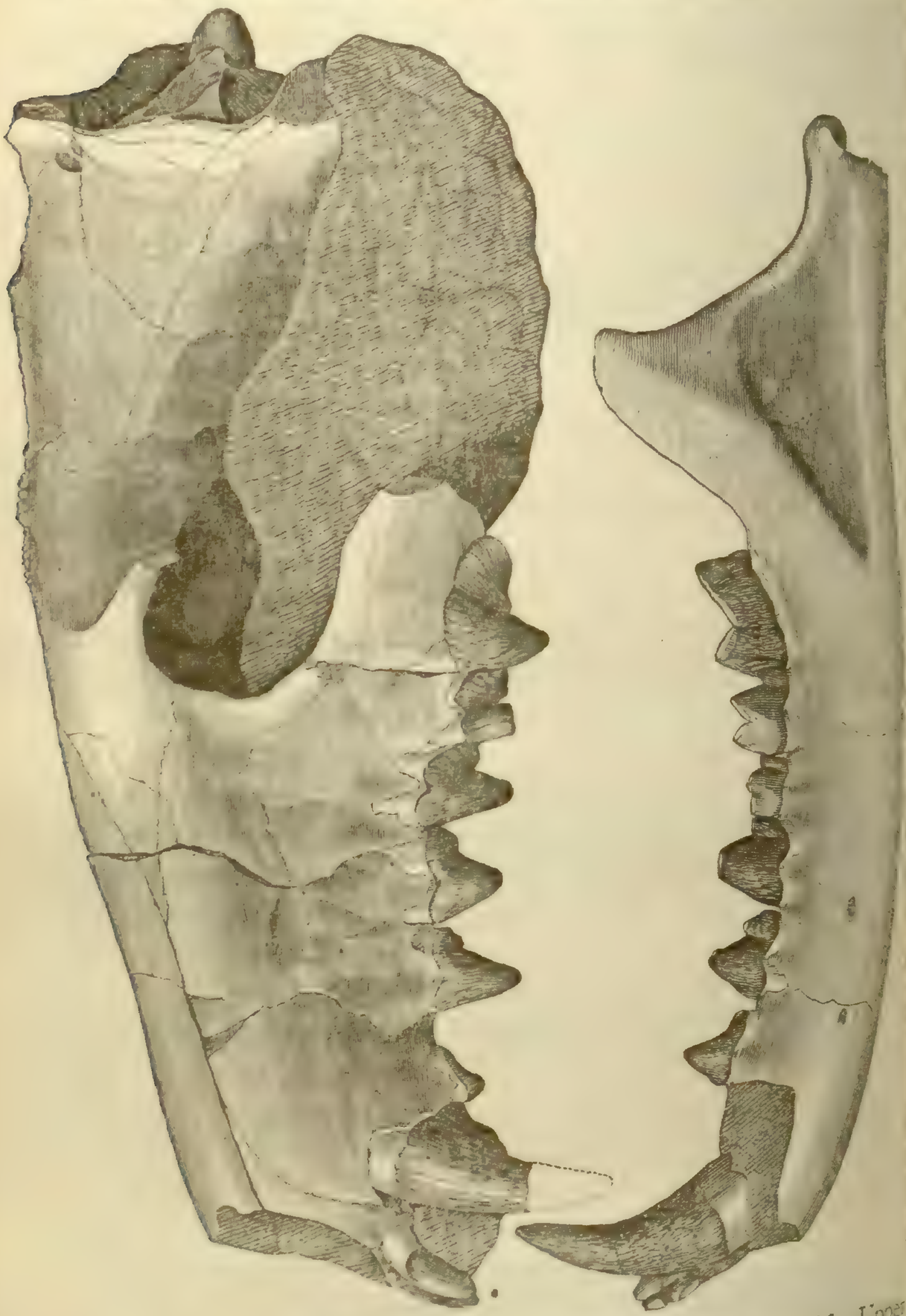
"The brain case attributed by Gervais to Hyænodon must belong to some other genus, or else our American species differ very radically from the French. In the American species the brain is relatively very small and simple, being but slightly larger than that of Thylacynus, to which animal Hyænodon presents many interesting approximations in the structure of the skull and teeth. The cerebellum of Hyænodon is entirely uncovered by the hemispheres, which in their turn seem to have but three straight longitudinal gyri, presenting the simplest type of the carnivorous brain."

It is highly probable that this family is a derivative of a pentadactyl form of the Mesonychidæ. Its appearance in time corresponds nearly with the disappearance of the latter.

But one genus of this family has been thus far described, the Hyænodon of Laizer and Parieu. Its dental formula is I. $\frac{3}{3}$; C. $\frac{1}{1}$; P-m. $\frac{3}{4}$; M. $\frac{3}{3}$. The last three molars in both jaws are sectorials, and the last of these are the largest, and form the most effective shears for the dividing of animal tissues. The position of these teeth indicates a mouth fissured far posteriorly, and a correspondingly posterior position of the masseter muscle. This structure indicates a weak power of prehension of the canine teeth. This character is sustained by the frequently anteriorly directed inferior canines, and the generally slender mandibular rami. The Hyænodons must be regarded as snappers, and not capable of holding on to a living enemy with much persistency.[1] They were evidently weaker in all points of organism than the modern Carnivora, which no doubt accounts for their extinction. Thirteen species have been described, all but three North American forms being French. The oldest of these, the *H. parisiensis* Kefst., is from the Upper Eocene or Oligocene, or the Paris Gypsum, but its reference to this genus is not yet certain. Gaudry, however,

[1] See On the origin of the sectorial tooth of the Carnivora, AMERICAN NATURALIST, 1876, p. 171.

states that Hyænodon occurs in the Gypse. Seven species are described by Filhol as from the Phosphorites. Some of these (as *H. leptorhynchus* L. & P.) are elsewhere found in the Stam-



pian, a Lower Miocene, but some of them are probably Upper Eocene.[1] The three North American species are from the White

[1] Professor Gaudry thinks the Phosphorites include fossils of different Tertiary epochs.

River or Oligocene horizon, and no species is known from later formations. The species range in size from that of the *H. vulpinus* Gerv., which equals a red fox, to that of an American black bear, as the *H. heberti* Filhol, and *H. horridus* Leidy (Fig. 12). The latter species is from the bad lands of Nebraska.

Leptictidæ.[1]

This family is very nearly related to the Centetidæ, which are now living in Madagascar. The only character by which I dis-

Fig. 13.—*Stypolophus whitiæ* Cope, skull and part of posterior foot of two individuals, two-thirds natural size. Figs. *a–b* from the Wasatch beds of the Big Horn river, Wyo. Figs. *c–d* from the basin of the Wind river, Wyo. Fig. *c*, internal side of part of right mandibular ramus. Fig. *d*, left tarsus minus cuneiform bones, from above. Original, from Vol. III, Report U. S. Geological Survey Terrs., F. V. Hayden.

tinguish it is by the presence of the zygomatic arch, a part of the skull which is absent in the Centetidæ (Fig. 13). The Leptictidæ

[1] This family is included in the Centetidæ in the first part of this paper, p. 261.

are no doubt the ancestors of the Centetidæ; and their later types, as Leptictis, approach the existing family in their dentition quite closely.[1] The earlier types display great variety in their dentition, and give ground for distinguishing many genera.

Two groups are easily recognized among the Leptictidæ. In the first of these the last or fourth inferior premolar is a simple premolariform tooth, different from the inferior true molars, and without any internal cusp. In the second division the fourth inferior premolar is either like the true molars or approximates their form by the presence of an internal tubercle. To the latter group belongs the genus Chriacus, which from the slight development of the fourth inferior premolar (Fig. 14) approximates the first division. The genus may, however, be improperly referred to the Creodonta.

Fig. 14.

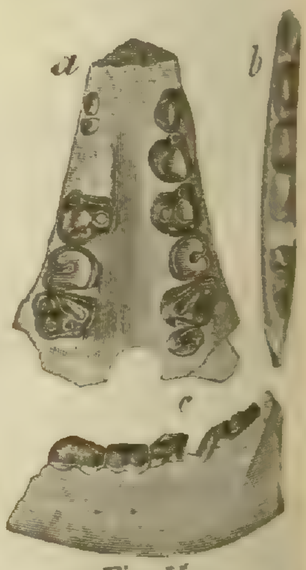


Fig. 15.

FIG. 14.—*Chriacus angulatus* Cope, right ramus of mandible and part of maxillary bone with teeth; from the Wasatch beds of the Big Horn, Wyoming. Figs. *a*, *d* twice natural size. Figs. *b–c* natural size. Fig. *a*, first and second true molars from below; *b*, ramus from external side; *c*, the same, internal side; *d*, the same from above. FIG. 15.—*Mioclænus turgidus* Cope, part of skull and lower jaw of one animal, two-thirds natural size. From the Puerco beds of New Mexico. Original, from Vol. III, Report U. S. Geol. Survey Terrs.

There are seven genera of the first division of the family. These may be distinguished into two sections. In one of these there are three well-developed anterior cusps of the inferior true molars forming a tubercular sectorial tooth; in the other the anterior

[1] Enough is now known of the mammalian fauna of Madagascar to convince us of its decidedly Miocene and, to some degree, Eocene character. The lemurs and Centetidæ approximate nearly the Eocene types; the Chiromys is near the Eocene Tillodonta, while the closest allies of the carnivorous genus Cryptoprocta are found in the Lower Miocene of France and the Middle Miocene of Oregon. The Oligocene descendants of the Eocene types appear to have persisted in Madagascar. The reptiles are not African but are South American.

cusp is rudimental or wanting, and the tooth approximates more or less the quadrituberculate condition. In the latter subsection there are three genera. The first of these, Mioclænus Cope, has the inferior true molars quadrituberculate and of equal elevation; the first true molar may have an anterior or fifth tubercle. The external cusps of the superior true molars are distinct and conical. In Triïsodon Cope, the inferior true molars only are known. These have four cusps with a rudimental anterior fifth. They differ from the corresponding cusps in all the other genera in being compressed so as to have fore and aft cutting edges. Diacodon Cope, is the third genus. Its superior molars are like those of Mioclænus, but the two anterior cusps of the lower true molars are much elevated, the posterior are rudimental, and there is a rudimental fifth in front.

Mioclænus presents the only truly quadritubercular lower molars in the suborder. It is so far known only from the Puerco or oldest Eocene of North America. There are nine species known

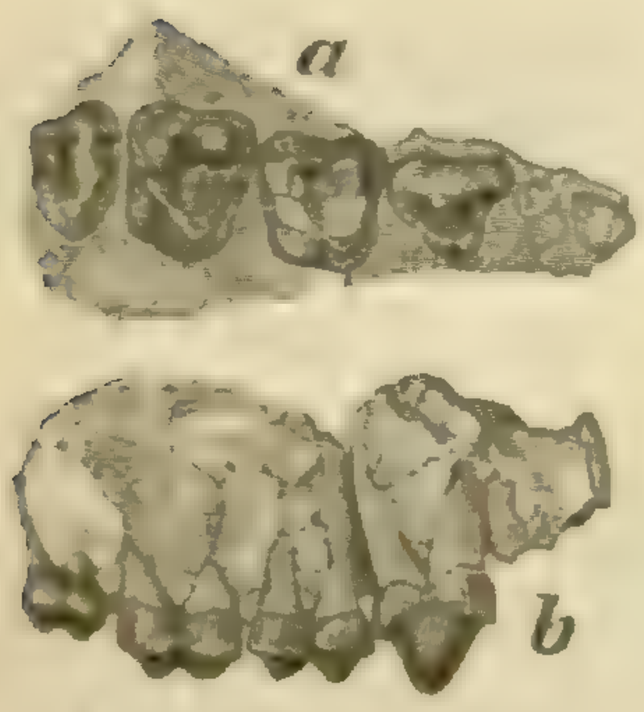


Fig. 16.

Fig. 17.

FIG. 16.—*Mioclænus corrugatus* Cope, last four molars on maxillary bone from below, two-thirds natural size. From the Puerco beds of New Mexico. Fig. *a*, from below; *b*, from right side. FIG. 17.—*Mioclænus subtrigonus* Cope, parts of maxillary and mandibular bones two-thirds natural size; from the Puerco beds of New Mexico; *a*, superior true molar teeth from below; *b*, left mandibular ramus, external side; *c*, do. inner side; *d*, from above. From Report U. S. Geol. Survey Terrs., Vol. III.

so far, which range from the size of a mink (*M. minimus*) to that of a wolf (*M. ferox*) in the sizes of their jaws, but in the case of the *M. ferox*, of which a good deal of the skeleton is known, the body was relatively smaller. The species differ in the form of the third superior premolar, and in the robustness of their inferior premolars. The *M. turgidus* (Fig. 15) represents the type with robust premolars, and the *M. subtrigonus* (Fig. 17) those with more compressed premolars.

We can read the nature of the primitive mammal, *Mioclæ... ferox*, in so far as the materials permit. It was an effective flesh-eater, and probably an eater of other things than flesh. It had a long tail and well-developed limbs. It had five toes all around and the great or first toe was not opposable to the others, and may have been rudimental. The feet were plantigrade and the claws prehensile. The fore feet were well turned outwards. There were, perhaps, marsupial bones, but this point is not yet certainly determined. The presence of a patella distinguishes it from marsupials in general. Its embracing glenoid cavity of the skull, and form of the inferior molars, resemble those of the Arctocyonidæ.

This species is about the size of a sheep. The bones are stated by Mr. Baldwin, who discovered it, to be derived from the red beds in the upper part of the Puerco series.

The genus Triïsodon includes as yet but one species, the *T. quivirensis* Cope, which is only known from the rami of the lower jaw. These bones are shorter and more robust than those of the coyote, and indicate an animal of perhaps the size of the wolverine (Fig. 1, p. 257). It was evidently strongly carnivorous in its diet, and was a capable biter. Its remains are from the Puerco of New Mexico.

Diacodon includes seven species, two from the Wasatch Eocene, the others from the Puerco. The former are much the smaller (Fig. 18), while those of the Puerco vary in dimensions from the size of a common weasel (*D. assurgens*) to that of a wolf (*D. conidens*). The five species of the Puerco were formerly referred by me to the genus Triïsodon, but are now more properly placed in Diacodon. The only species in which the superior molars are known is the *D. conidens*, where they are generally identical with those of Mioclænus.

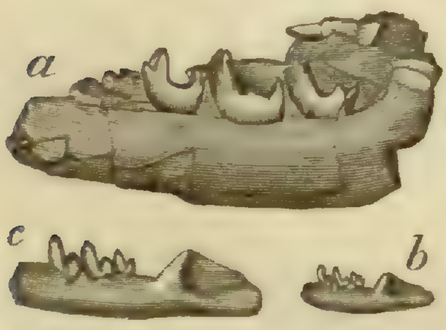


FIG. 18.—Jaws of species of Diacodon from the Wasatch bed of New Mexico. Fig. *a*, *Diacodon alticuspis* Cope, right mandibular ramus, inner side, twice natural size. Fig. *b*, *D. celatus*, left mandibular ramus, natural size; *c*, same, twice natural size. Original, from the Report U. S. G. G. Surv. W. of 100th mer., G. M. Wheeler.

Of the four genera of the first division of the Leptictidæ, which possess tubercular sectorial teeth, but two are found in North America, while three of them have been discovered in Europe.

The typical and most widely distributed genus is Stypolophus

Cope (Fig. 13). It has compressed premolars, except the fourth superior, which is conic with two basal lobes. In Proviverra Rutimeyer, this tooth is triangular and cutting. One species has been found in the Swiss Eocene. Quercitherium of Filhol is distinguished by its very robust premolars. Like Proviverra it has but one rather small species. It is from the French Phosphorites. Stypolophus has the two cusps of the superior true molars close together, forming twin cusps, and they have behind them a heel, which is cutting. Two species have been discovered in the French Phosphorites, one of which, the *S. caylusi* of Filhol, is preserved to us in the most perfect skull of a Creodont known. From it I have restored the skull of the *S. whitiæ* (Fig. 13). It has elevated sagittal and posterior crests for the insertion of the temporal muscles, and the brain-case is very small. A cast of the brain displayed to Mr. Filhol the following characters: The hemispheres are small, and leave the cerebellum and the posterior edge of the middle brain uncovered. Anteriorly they contract to an isthmus which separates them from the large olfactory lobes. The hemispheres display three longitudinal convolutions, and very little indication of sylvian fissure. Of the American species, five are known from the Wasatch, and four from the Bridger beds.

Nearly allied to Stypolophus is the genus Didelphodus Cope, which only differs from it in the possession of but three superior premolars. The single species, *D. absarokæ* Cope, is about the size of a skunk, and has been obtained in the Wasatch Eocene beds of the Big Horn river, Wyoming (Fig. 19).

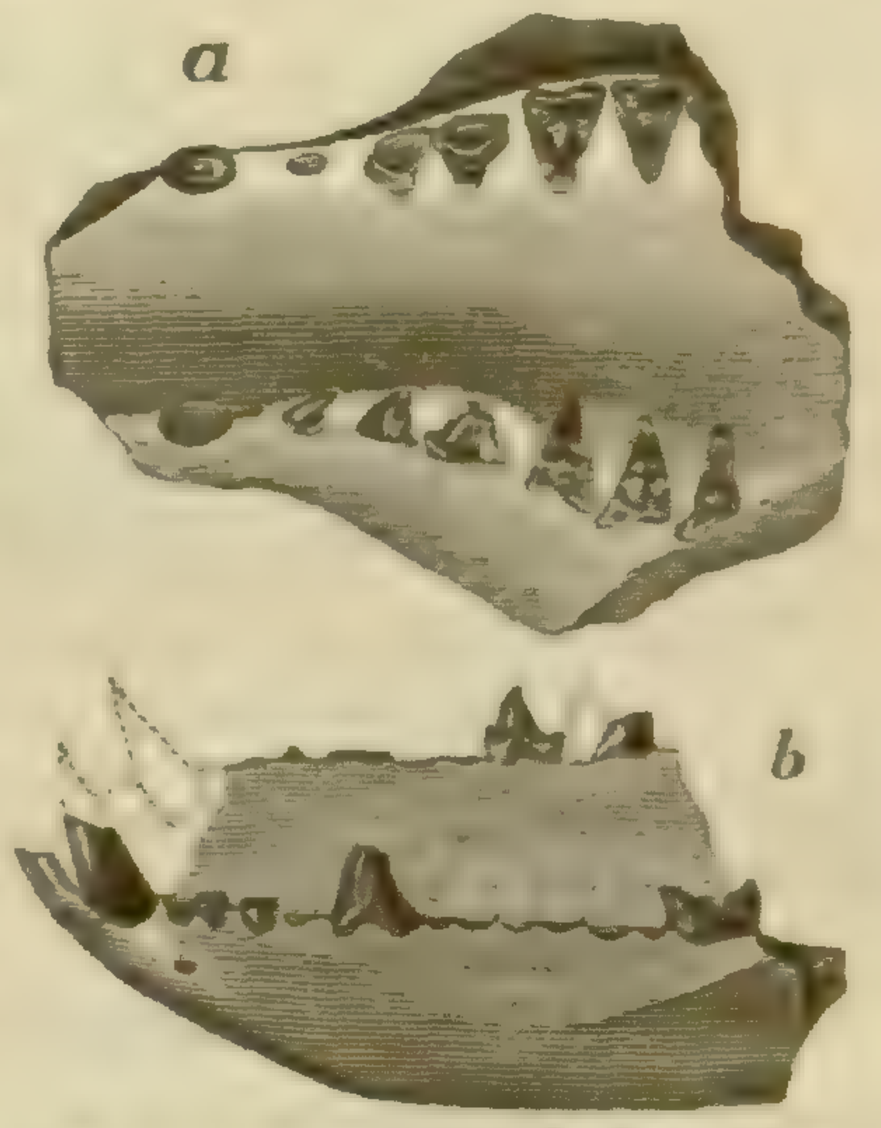


FIG. 19.—*Didelphodus absarokæ* Cope, muzzle and corresponding part of mandible of one individual, natural size. Original, from Vol. III, Report U. S. Geol. Surv. Terrs.

There are six genera of the second section of the family Leptictidæ, *i. e.*, those with the fourth inferior premolar more or less like the true molars. In five of these genera the canines and incisors have the proportions usual in carnivorous animals, but in the sixth, Esthonyx Cope, the canines are smaller than some of the incisors. In this respect Esthonyx esembles some of the genera of

Centetidæ, and other recent families both of Creodonta and Insectivora (Fig. 23). Of the genera with large canines, Chriacus has already been mentioned as having a simple fourth premolar with only an internal cusp to distinguish it from the genera of Sect. 1 of the family. Its true lower molars have an anterior V of three connected cusps. This is also the character of the inferior molars and fourth premolar of Deltatherium (Fig. 20), which is also peculiar in having but $\frac{3}{3}$ premolars, and a diastema. In the three genera which remain, the anterior or

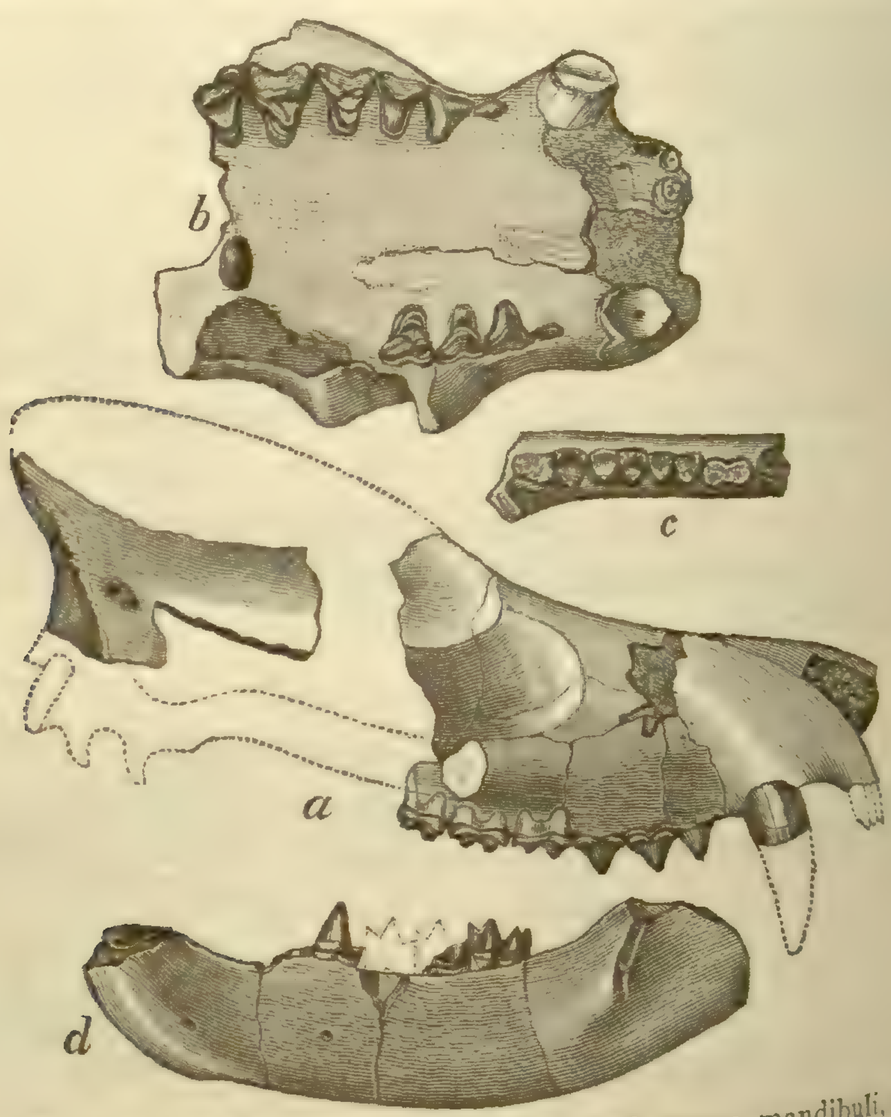


FIG. 20.—*Deltatherium fundaminis* Cope, skull and ramus mandibuli, two-thirds natural size, from the Puerco beds of New Mexico. Figs. *a b c* from one individual; Fig. *d* from a second animal. Fig. *a*, right side of cranium; *b*, palate, from below; *c*, mandible, part, from above; *d*, left ramus, outer side. From the Rept. U. S. Geol. Survey Terrs., Vol. III. Original.

fifth cusp of the true molars is rudimental. They differ from each other in the structure of the third superior premolar. In Ictops Leidy, this tooth has two external and one internal cusps; in Mesodectes Cope, there are one external and one internal cusps, and Leptictis Leidy, there is no internal cusp, and the external one is simple.

There are certainly three, and probably four, species of Chri-

acus. The typical and largest species, *C. pelvidens* Cope, is from the Puerco Eocene of New Mexico; the smallest species, *C. angulatus* Cope, is from the Wasatch beds of New Mexico and Wyoming (Fig. 14). Perhaps it is near this genus that Tricentes Cope, should be placed. The latter only differs from Chriacus in the possession of but three superior premolars.[1] I have suspected that it belongs near Microsyops and Mixodectes in the Lemuroid series. There are three species, none larger than a skunk. The type, *T. crassicollidens*, is known from parts of two crania. The *T. inæquidens* was not larger than a gray squirrel.

The *Deltatherium fundaminis* Cope (Fig. 20), is one-half larger than the Virginian opossum, and much more robust. Its molar teeth are very opossum-like, while its canine teeth are relatively larger and stouter. The crowns of the canines are especially effective as weapons, from their vertical direction and form, their sharp anterior and posterior cutting edges, and their sides grooved like many blood-letting instruments. The sagittal crest is high, and the muzzle is short and wide, so that a decidedly bull-dog expression belonged to this animal. It is the most specialized form of the family and of the Puerco epoch, and was one of the most abundant. There are two other less known species of Deltatherium.

(To be continued.)

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ANATOMY AND PHYSIOLOGY OF THE FAMILY NEPIDÆ.

BY WILLIAM A. LOCY.

(Continued from page 255.)

The Salivary Glands.—The most anterior appendages to the alimentary canal are the salivary glands. These are especially well developed in the Hemiptera, and secrete a juice which doubtless aids in the digestion of food. The Nepidæ have four glands in two pairs, each pair consisting of a small gland and a large one, which open by ducts near the commencement of the œsophagus. The large glands, which are about five times the length of the small ones, extend back to the first abdominal segment, and are there united to the stomach by threads of tracheæ. At the anterior ends of the large glands are two round pouches, which probably serve for the storage of small quantities of saliva.

[1] See Proceeds. American Philosoph. Society, 1883, p. 315.

Connected with the salivary system, but separate from th glands, are two sigmoid pouches, called salivary reservoirs, wh are supposed to serve for storing larger quantities of saliva. Th are applied to each side of the stomach, at its commencem and are continued backwards by a tubular appendage, which en blindly in the first abdominal segment, being there attached t the stomach and to the large salivary gland by tracheary thre The ducts of the reservoirs are kept open by a transversely st ated ribbon, coiled in a spiral manner, and thus are similar to th tracheæ in structure.

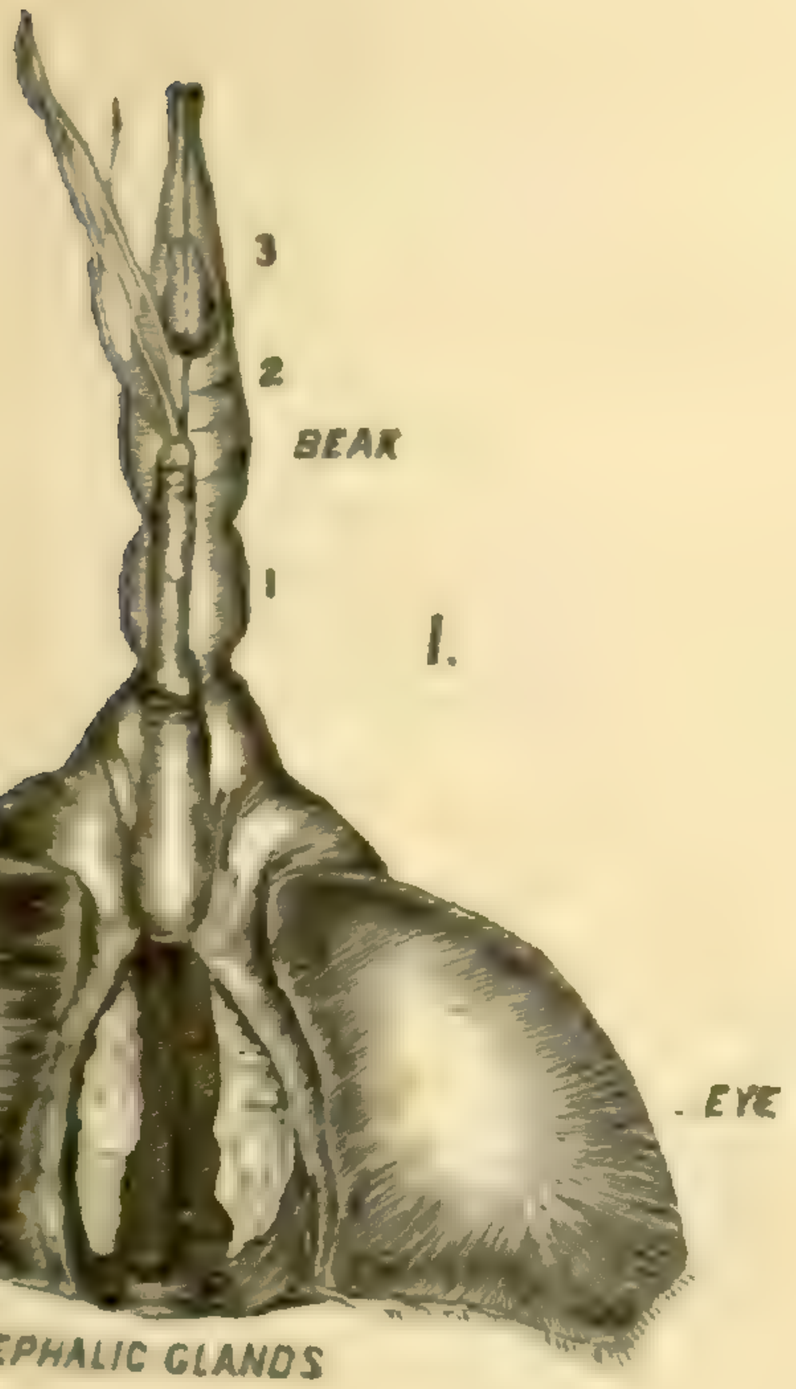
The salivary glands are conglomerated and, therefore, of hi order. The globules are closely packed, sessile, and situat upon tubules, which join with others of like origin, and emp their contents into a common duct.

Comparatively speaking, the glands in Ranatra are not as l as those of Belostoma, and the salivary pouches, at the front are lacking. The salivary reservoirs are lenticular, and the cæcal appendages are longer than in Belostoma.

The Malpighian Tubules.—The Malpighian tubules, so name from their discoverer, Malpighi, are appended to the intestin They consist of two tubules, of small and uniform size, united four insertions to the bulbous enlargement of the intestine: eac insertion is mediate, *i. e.*, connected with a pouch which opens to the intestinal bulb. These tubes are much convoluted an matted about the bulb, and are closely applied over the intestin extending also over the stomach and into the fat body. On count of the difficulty with which they are unrolled, no ex measurements of their length has been made. I should jud however, th[illegible] six or eight times the length o body.

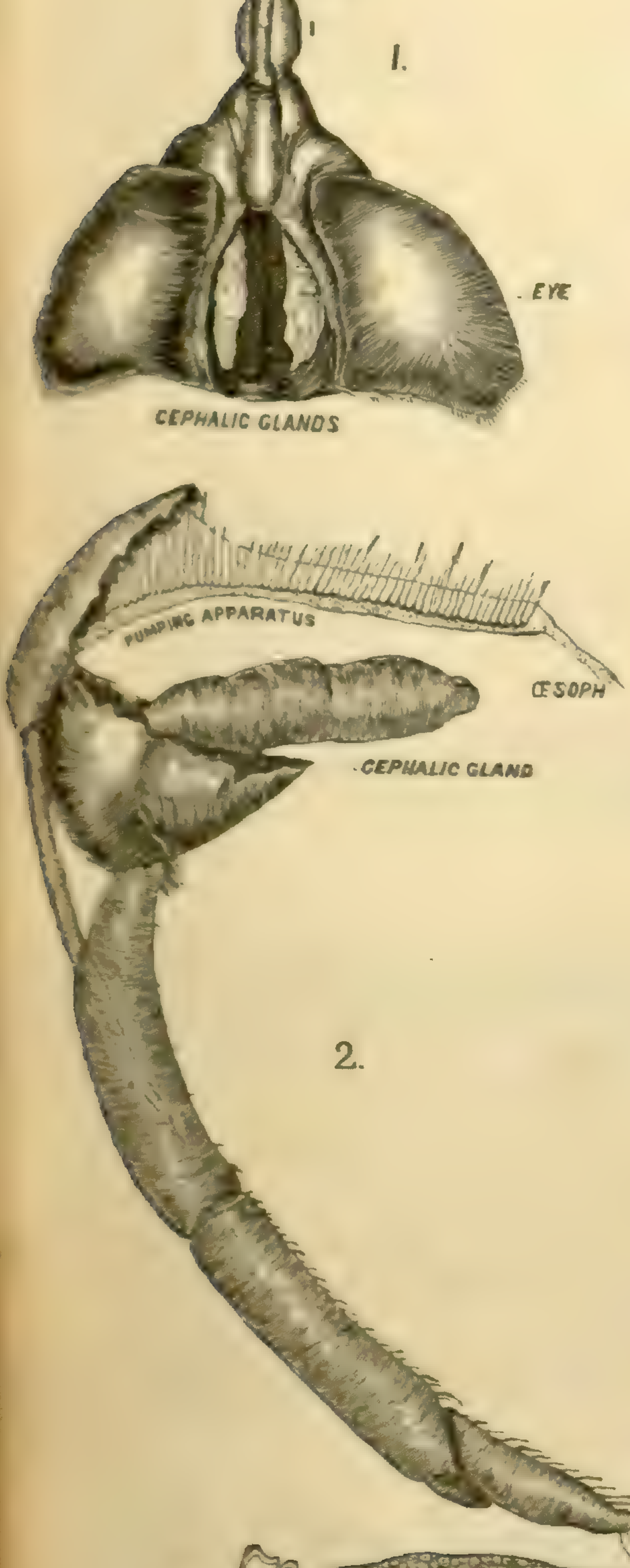
They have b[illegible]
on account of [illegible]
acid and other urinary products in [illegible]
them a urinary function. It is possible, that in some ca unite with this urinary function the secretion of a sort of bile. opinions of anatomists of the past half century regarding their fu tion are various. By Cuvier, Dufour and Carus, their function believed to be biliary, and by Strauss-Dürckheim and other omists urinary. These contrary opinions were, in a measu reconciled by the views of Lacordaire, who believed their funct

PLATE IX.



1.

CEPHALIC GLANDS



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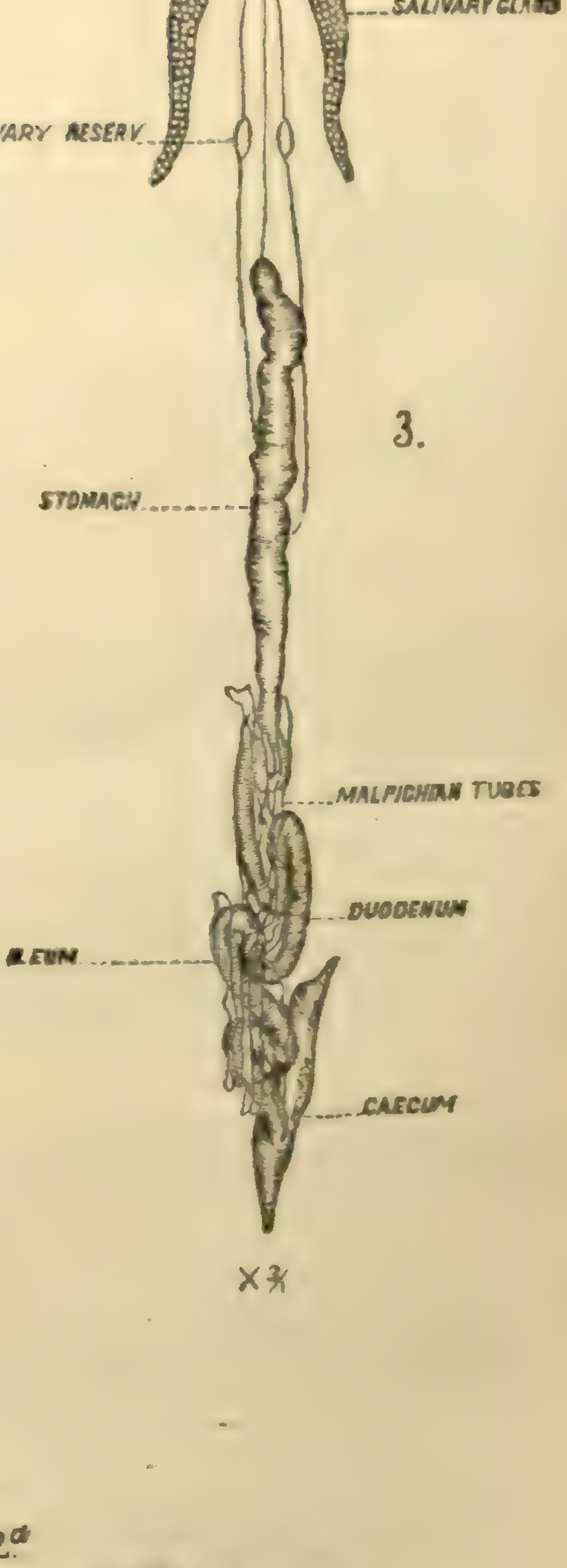

3.

X 3/

2ª

to differ according to position on the alimentary canal, of which, in the Insecta, there are three—on the stomach, biliary alone; on the post-ventriculus, urino-biliary; at the extremity of the alimentary canal, urinary alone. According to this view they would be urino-biliary in the Nepidæ. I am not prepared to speak concerning their function, as I have made no analysis of their secretions.

The Fat Body.—The internal organs are entirely enveloped in a fatty tissue, called the fat body, which divides the heart and the nervous system from the other organs of the body. It is composed of connective tissue holding in its meshes globules of fat. This fat body is always a serious encumbrance in tracing the respiratory system, and it also obscures other internal organs. The fat may be dissolved in sulphuric ether, after which the branching of the tracheæ may be studied. This tissue is most strongly developed in the abdomen, and in the Nepidæ I have noticed that it is thickest in the fall, and becomes thinner when the insect is deprived of food; it is probably, therefore, a storehouse of nourishment, and may also serve as a protection to the internal organs.

The Odoriferous Glands.—In Belostoma, the odoriferous glands are two cæcal pouches situated in the metathorax, under the commencement of the stomach. They are convoluted several times upon themselves, and the distal and anterior ends are close together, both concealed under the nervous cord; the external opening is between ths coxæ of the posterior legs. When extended, they will reach to about the fifth abdominal segment. The smell emitted by these glands is pleasant, resembling that of well ripened pears or bananas.

The Glands of the Head.—In the genera, Belostoma, Perthostoma and Ranatra, I have observed two glands within the head, similar in position to the green glands of the Crustacea, which I shall provisionally name the *cephalic glands*, since they are not mentioned in any authority to which I have access. (Plate IX, figs. 1, 2 and 2*a*.) They are on the floor of the head cavity beneath all the other organs, and therefore are most easily approached from beneath. Their external openings are on each side of the head, between the eyes and the base of the beak. The ducts are short, and seem to be composed of a number of united ducts, which originate in individual cells. Under the microscope these glands show a thin homogeneous enveloping layer, and an

epithelial layer composed of five-sided cells, each containing a prominent central nucleus. In some cases two nuclei are present. When these insects are irritated, a secretion is freely thrown out around the base of the beak, which produces death very quickly when introduced on a needle point into the body of an insect. The "cephalic glands" may be the source of this poisonous secretion on the other hand their function may be entirely different; this question may be decided by the chemical analysis of the secretion of these glands, that is now being made in the University of Michigan.

II. The Circulatory System.

After the food is reduced to chyle in the alimentary canal it passes by osmosis through the walls of the intestines into the general circulation; it is conveyed in this way to various parts of the body, and converted into tissue. The circulation of the blood and the structure of the heart in insects is considered one of the most difficult points in their physiology, on account of the delicacy of the structure involved, and the confusion that has arisen among authorities from the absence of true arteries and veins. So much interest and importance is attached to this subject, that I give below a brief history of it.

About the middle of the seventeenth century Swammerdam and Malpighi, each independently, discovered in the larvæ of certain insects a rhythmically contracting vessel lying along the back, which they considered a heart. In the course of time Lyonet threw some doubt upon this conclusion in his memorable work on the larva of *Cossus ligniperda*. This doubt was increased by Cuvier, who, after a special study of circulation in insects, gave as his opinion that no such thing as a regular circulation existed in this class of animals. Thus naturalists came to believe that insects had no circulation.

In the early part of the present century, however, Carus made the true discovery of the circulation of blood in the Insecta, and his proof was too strong to admit of question. He saw, with the aid of his microscope, in a small transparent insect, blood leave the heart, circulate through the limbs, wings and antennæ, then return to its starting point, thus tracing the complete circulation. His results were published in the year 1827, and were soon confirmed by other naturalists.

In studying this subject in the Nepidæ, I have imprisoned

larvæ of Belostoma, Perthostoma and Ranatra in flat glass boxes, and, with the microscope, have studied the heart, and traced the circulation through the transparent integument.

The *heart* here described is from dissections of Belostoma. It consists of a long tube extending from the sixth abdominal segment to the supra-œsophageal ganglion. In the abdomen, it is divided into chambers, and this abdominal portion is considered the heart proper, and the anterior tubular portion, the aorta. There are five chambers in the abdomen of the adult, with afferent openings on each side, called by some auriculo-ventricular apertures. At the beginning of the sixth abdominal segment, the heart is attached to the integument by means of muscles. (Fig. 4.)

The first pair of afferent openings are thus thrown into the fifth abdominal segment, and the three following segments have one pair each, making a total of four pairs. These openings are guarded by valves, the action of which will be considered later. These apertures are all anterior to the middle of the body segment in which they are situated. In the larvæ of Belostoma, I have often observed one of these auriculo-ventricular openings in the sixth abdominal segment, and muscular attachments behind it in the anal prolongation. It is my belief that this additional chamber is dropped in the adult form, since I find it in none of my dissections. It is a matter of great difficulty to be sure, whether one of these chambers may not have escaped notice. According to my observations, however, there are five chambers in the adult Belostoma and six in the larva. At the junction of the thorax and the abdomen, the heart bends downward as it extends forward, passing under the large muscles of the thorax.

The triangular Muscles of the Heart.—The heart is attached to the integument in the abdomen, by a number of triangular muscles with their apices pointing outward. I have counted eight pairs of these attachments in the adult Belostoma. They are situated opposite each auriculo-ventricular orifice, and continue both anteriorly, and posteriorly, beyond these openings. At the apex the fibers composing the triangular muscles are closely united into a sort of ligament. These fibers diverge laterally as they approach the heart, and also divide into two sheets, one passing above and the other below the heart. Thus a triangular cavity is left on each side of the heart, which is called the *pericardial*

sinus. According to Milne-Edwards this has some claims to be considered the auricle of the heart, since its muscles help force the blood through the afferent openings into the heart. In addition to the triangular muscles, the heart is attached in the thorax by a single triangular piece of connective tissue.

The heart beats rhythmically, its activity depending greatly upon whether the insect is quiet or excited. As near as I could conclude, the normal number of beats in Belostoma larvæ is about forty-five per minute. In those confined in glass boxes the number of beats were from thirty-four, to sixty-three, per minute.

The contraction of the different chambers is not quite synchronous; the back chamber contracts first, then the others follow in quick succession, so that the blood is kept constantly moving forwards. At the beginning of the diastole of the heart, the valves guarding the afferent openings bend inward with a quick, almost jerking motion, and permit the entrance of blood from the pericardial sinus; upon the systole of the heart the pericardial sinus receives an accession of blood from the chambers leading to it the closing of the valves of the afferent openings prevents the return of blood from the heart to this cavity. It has been determined by the investigations of Dogiel, and others, that the heart is kept beating by ganglionic corpuscles, like the heart in vertebrates.

The course of the blood is forward in the heart to the nervous ganglia of the head, where the aorta ends in a funnel expansion. From here the blood is thrown into the lacunæ which are regular channels leading through the connective and among the organs of the body. Although there are no arteries and veins, the course of the blood is regular through lacunæ, and the heart may be easily injected by throwing into the body cavity. I have often injected the heart of the idæ by throwing carmine into the ventral cavity. The passes into the legs, wings, antennæ, etc., and comes back two large currents passing backward along each side of the ultimately it gets back to the pericardial sinus, from thence the heart to begin its course anew.

The Pulsatile Organs of the Legs.—Accessory to the circulation is a special system of pulsatile organs, found in the three pairs of legs of these insects, generally situated in the tibia just below the articulation with the femur. In the raptorial legs of Ranatra, however, the organs are in the clasp joint, or tarsus, below the articulation with the tibia.

PLATE X.

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X3/4

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X2/3

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Observations on their influence over the circulation, etc., will be found in the January number, 1884, of the AMERICAN NATURALIST, where my investigations and results are given, that lead to the three following conclusions on these organs: (1) They are separate from the muscular system of the legs; (2) they influence circulation; (3) they are automatic.

III. THE RESPIRATORY SYSTEM.

Connected with the respiratory system of the Nepidæ there is a breathing apparatus, which is peculiar to this family of insects. This characteristic consists of an anal *respiratory siphon* formed by the apposition of the grooved faces of the caudal setæ. Some aquatic larvæ have an analogous, though differently constructed breathing tube, which always disappears in the adult. The caudal setæ of Belostoma and Perthostoma are comparatively short, but in Ranatra are conspicuous for their length. In breathing, these insects rise to the surface and thrust their respiratory siphon out of the water. At the bottom of this tube are two anal stigmata opening into the two main lateral trunks of the respiratory system. In the adult insect,the anal stigmata are the only open ones in the whole abdomen. In addition to these Nepa and Ranatra have, on the ventral surface of each of the third, fourth and fifth abdominal segment, two prominent stigmata, which are closed by a sieve-like membrane and, according to Gerstaecker, perform the functions of tracheary gills.

In the adult Belostoma, the abdominal stigmata are so nearly obliterated that often their scars can be scarcely found with a lens; but the case is strikingly different in the larval forms, which have six prominent stigmata on the last five ventral segments. The last abdominal segment bears two pairs, and each of the four following, one pair each. I noticed in some cases, a spot on the membrane between the first abdominal segment and the mesothorax, which is, perhaps, an additional stigmata, though the work on this point is not very definite. The stigmata show a vestibule on cross section, and lie in a hairy track with their openings guarded by hairs.

The chief external differences between the abdomen of the larva and of the adult Belostoma may be summed up as follows:

Larva.—The ventral surface is covered with rather coarse hairs, the dorsal surface smooth, the stigmata prominent and all open,

the sixth abdominal segment comparatively small, and the caudal setæ undeveloped.

Adult.—The ventral surface is smooth, the dorsal surface pubescent, the stigmata totally obliterated, and the caudal setæ developed.

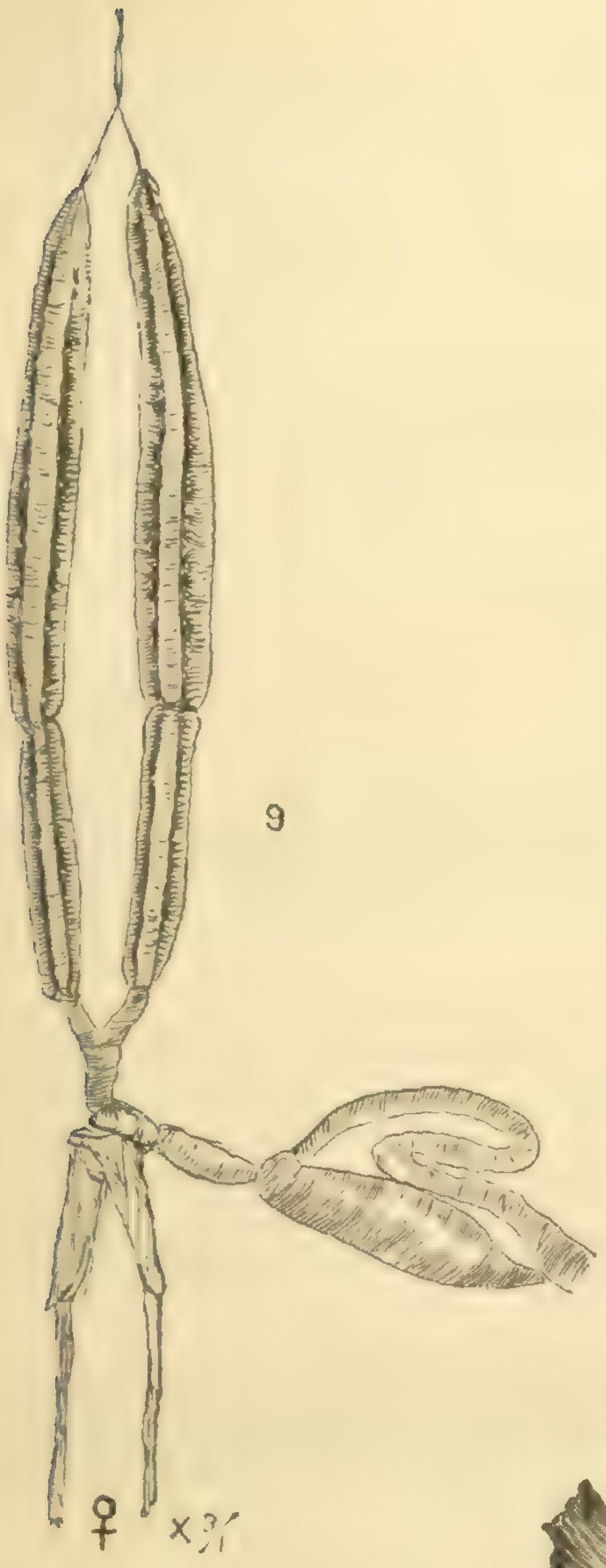
The tracheary branches are distributed to all the organs of the body, so that the chemical processes of respiration are effected throughout the body instead of at special points. From the anal stigmata, two main trunks extend along the abdomen on each side of the heart, giving off and receiving branches which anastomose among themselves. The large trunks are connected by an arcade of tubes running below the intestines. In the larva, branches from the spiracles join the main trunks, and in the adult, after the obliteration of the spiracles, these branches are still found attached to the integument. The distribution of tracheæ to the muscles and organs of the forward part of the body, is very plentiful; large branches extend into the legs and wings; in the mesothorax the nervous ganglion rests on a triangle of tracheæ. Here, too, connected with the trachea, are several air sacs, which are inflated before flight. The dorsal and ventral walls of the abdomen are connected by two vertical rows of muscles, which are doubtless concerned in respiration.

Three kinds of tracheæ are found in these insects: tubular, vesicular and parenchymatous. All the main trunks and branches of the respiratory system are composed of tubular trachea; this, as shown by Minot, consists of an external nucleated epithelium with two internal layers, in one of which is found the spiral thread that keeps the tube open. This spiral filament is not continuous, but separate in each branch, and consists of numerous parallel pieces, each of which tapers to a point after a few turns and thus is lost. The vesicular trachea of the air sacs chiefly differs from the tubular trachea, in lacking the spiral thread. I have made no study of the parenchymatous trachea noted by Dufour as occurring in Nepa. It consists, according to this author, of several pouches covered by a fine, satin-like envelope within which, minute tracheary branches are matted. These pouches are situated in the thorax under the Scutellum.

B. The Function of Reproduction.

The function of reproduction, which includes generation and development, is here confined to generation. As in the Verte-

PLATE XI.



brata so in the Insecta, two kinds of organs are concerned in this process, the mutual action of whose products upon each other, is usually necessary for the formation of new individuals. These organs are the male organs or testes, producing spermatozoa, and the female organs or ovaries, producing eggs.

I. The Male Generative System.

The testes of the male Belostoma lie in the anterior portion of the abdominal cavity, on each side of the pyloric end of the stomach. They consist of a rounded body, which in reality is a membranous sac, mounted on a sort of receptacle composed of five pieces closely packed together. From each of these five pieces, arise spermiferous tubes which are much matted in the membranous sac. (Fig. 12.) The vas deferens, which leads backward from the testes, is thread-like for the first half of its course, and then enlarges into a tube, which joins with the one from the opposite side to form the ductus ejaculatorius, which conducts the spermatic fluid to the organ of intromission. (Fig. 11.) This is formed by two pieces, a pick-shaped structure above and a spoon-shaped one below it; both organs are situated on the genito-anal prolongation, which corresponds to a dorsal and ventral part of a seventh abdominal segment. The prolongation is provided with copulatory hooks, which in the female are rudimentary.

In Ranatra, the general arrangement of the generative apparatus is the same, though in detail, somewhat different. The spermiferous tubules are confined in an elongated sac, which is much farther forward than in Belostoma, and the vas deferens, after enlarging, is coiled several times upon itself before passing into the ductus ejaculatorius (Fig. 10.) The coils are compact and form a lenticular enlargement on the vas deferens, sometimes mistaken for the testes.

II. The Female Generative System.

The ovaries of the female consists of two series of five tubes each, one on either side of the body. These terminate in the thorax, where their small pointed ends are joined together by connecting threads, which serve also to attach them in the thorax. Proceeding outward they gradually grow larger until they all meet at the calices, the tubes of which unite to form the vagina or oviduct. These organs vary greatly in size according to the season, sometimes quite contracted, and sometimes so distended with

eggs as to fill nearly the whole abdominal cavity. The tubes of the ovaries double upon themselves in the first segment of the abdomen, the flexure reaching back nearly to the third segment. (Fig. 14 *a*.)

As already noted, the females of Perthostoma carry their eggs upon their backs until hatched, the young then escaping by means of a trap door at the top of the egg. The number of eggs borne by any insect is variable; I counted them in four individuals with the following results: 207, 185, 184, 183, and other females were dredged bearing less than half as many. The eggs of Ranatra and Nepa are crowned with setæ, two on the eggs of Ranatra and six on those of Nepa, while the eggs of Belostoma and Perthostoma have none.

The female generative organs of Ranatra lack the flexure that occurs in those of Belostoma, but in other respects are quite similar. Their chief differences may be seen on reference to Figs. 8 and 9, Plate XI, which are drawn on the same scale.

C. The Function of Relation.

To secure a just harmony in the activity of the different organs of the body, a combining organ of some kind is necessary. The food must be adequate to meet the waste of the body. Intelligence to know when food is needed, and to discriminate between nutritious and innutritious food is essential; respiration must be regulated to supply enough oxygen, but not too much. These and all other processes of animal life must be brought into relation with each other, otherwise the organs would be useless. This round of duties, which is performed by the nervous system and the muscles, over which it has control, constitutes the function of relation. In some respects it is the most important function, since it directs all the others.

I. The Nervous System.

The insects of this family are keen and shrewd in detecting their prey, and energetic in procuring it, hence their general nervous condition must be an active one. They show a considerable degree of cephalization, all the abdominal ganglia have advanced to the mesothorax, where they unite with others to form a complex thoracic ganglion. The remaining ganglia form two conglomerate masses, one below the œsophagus, called the infra-œsophageal ganglion, and the other above, called the supra-œso-

phageal ganglion, sometimes considered the brain. This brain consists of two "cerebral lobes" slightly overlapping, and sending two large commissures around the œsophagus to the infra-œsophageal ganglion. The optic lobes, which are somewhat pear-shaped, extend obliquely from the summit of the "cerebral lobes" toward the eyes, and give rise to the numerous fibers of the optic nerves.

The cerebral ganglia send nerves to the antennæ, and also send a small branch to the frontal ganglion. This ganglion is a small knot of nervous matter situated on the median line of the head, just in front of the cerebral ganglia. The frontal ganglion supplies the œsophagus anteriorly, with nerve filaments and posteriorly, by filaments from a main branch extending backward underneath the "cerebral lobes." "The respiratory ganglia," which I did not find, are described by Dr. Leidy as "two small ganglia behind the brain, on each side of the œsophagus and connected with each other and with the 'cerebrum' by exceedingly delicate commissural filaments." From each side of the infra-œsophageal ganglion a bunch of nerves originates, which sends branches to the muscles and the organs of the prothorax, and to the anterior legs.

A double commissure connects the infra-œsophageal ganglion with the complex ganglion of the mesothorax. The latter gives off branches anteriorly, laterally and posteriorly. The anterior branches partly supply the prothorax; the lateral branches supply mainly the organs and muscles of the meso- and metathorax and the posterior legs; and the posterior branches, the muscles and organs of the abdomen (Fig. 17).

II. Organs of Special Sense.

Although there is good evidence of the existence of the special senses among insects, considerable speculation exists concerning the location of all, except the sense of sight.

Touch.—In these insects the sense of touch through the integument must be very blunt, and the real organs of this sense probably are the tactile hairs found on different parts of the body. These hairs communicate with the terminations of the nerve fibers beneath the integument. I have often been impressed with the idea, that the tufts of hair found at the extremity of the beak, in all the Nepidæ, are especial organs to give it a delicate sense of touch.

Taste and Smell.—The work on these insects as far as carried out, furnishes no suggestion as to the location of the senses of taste and smell, and, as far as my knowledge goes, their existence rests wholly on analogy. In some insects, as the Silphidæ, smell is obviously present and directs them to their food; and taste is probable in insects possessing soft tongues.

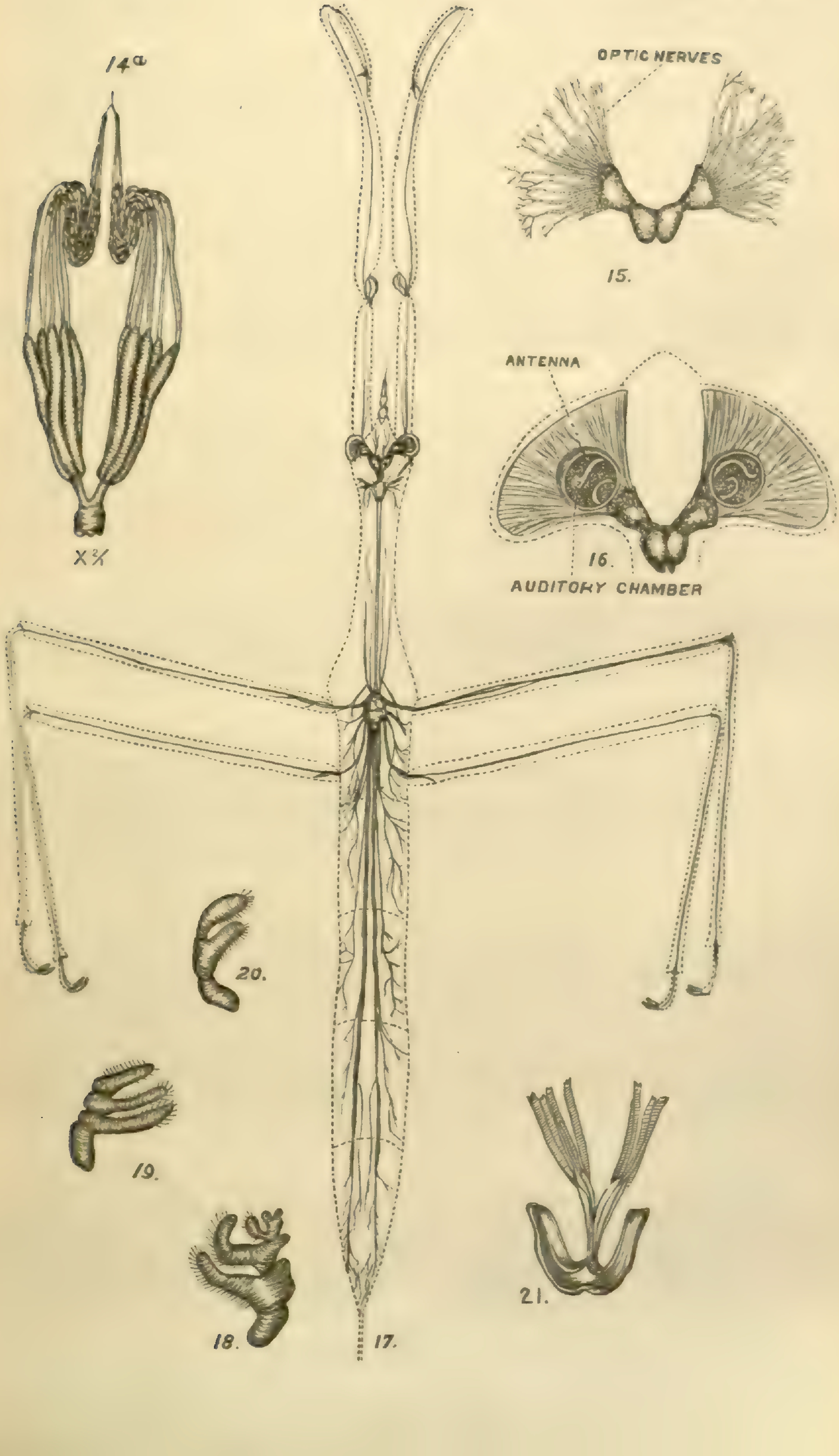
Hearing.—Hearing in the Insecta is usually located by anatomists in the antennæ. This is made very probable by investigations similar to those of Mayer, the physicist, on the mosquito. This observer, by watching through the microscope the hairs on a mosquito's antenna, found that they responded by vibrations to certain sounds that he produced; the hairs, being of different lengths, responded to several sets of vibrations, but always strongest to the note emitted by the female mosquito.

Other experiments of a similar nature, and the fact that some insects appear deaf when the antennæ are removed, add force to the conclusion that they serve as organs of hearing. A few insects, the Orthoptera, for instance, have special organs for the reception of sound, either on the thorax or at the base of the anterior legs.

In the Nepidæ, there are certain conditions in the situation of the antennæ that seem to me favorable for the increase of sound vibrations. The Belostoma and Perthostoma have each of the antennæ enclosed in a vaulted cavity, which is suggestive of a resonance chamber. Each chamber extends into the eye above it, and separates the fibers of the optic nerve into two bundles, and its opening below the eye is partly closed, so that a cleft is left toward the median line of the head, through which the antennæ may be protruded or withdrawn. The antennæ are well provided with sensitive hairs (Fig. 18), which doubtless respond to the sound vibrations received in the auditory chamber. In cross-section the auditory chamber presents a view shown in Fig. 15, Plate XII. The Ranatra emits a squeaking sound by working the front legs up and down on the joint at the coxæ, where the roughened surfaces come together.

Sight.—The Nepidæ have two prominent compound eyes, one on each side of the head, but no ocelli. They are covered externally by a modification of the integument, which answers to the cornea of the vertebrate eye. This is divided into a great number of hexagonal facets, underneath each of which is found a crystalline

PLATE XII.


14a
X 3/4
OPTIC NERVES
15.
ANTENNA
16.
AUDITORY CHAMBER
20.
19.
18.
17.
21.

cone with the apex directed backward. The filaments of the optic nerve are branched at their extremities (Fig. 15); each of these branches probably enters a cone. The theory of mosaic vision is so generally discussed that no repetition of it is needed here.

III. The Muscular System.

To bring an animal into true harmony with its surroundings, muscles are necessary to move the body from place to place, so that the animal may court agreeable, or favorable conditions, and shun disagreeable, or unfavorable conditions.

No special study of the muscular system of the Nepidæ has been made, but a few points that incidentally appeared during dissection are mentioned.

The most striking mass of muscular tissue is in the meta- and mesothorax, the muscles of which are mainly concerned in flight and in moving the limbs. The muscles of the legs are well developed, and may be studied through the integument if it is scraped thin. The elevators and depressors of the beak, and the muscles of the beak bristles, are easily demonstrated in the head and in the prothorax. The respiratory muscles of the abdomen, and the muscles of the pharynx, have already been described. In many cases special provisions for the attachment of muscles are provided by means of chitinous processes and chitinous threads. The latter are very conspicuous in the prothorax of Ranatra and in the retractor muscles of the setæ. The chitinous processes are found plentifully in the meso- and metathorax, and two prominent ones are borne on the back of the head.

Conclusion.—Even in this cursory view of the family Nepidæ, the adaptation of organism to function is often too obvious to escape notice. The influence of food and surroundings, the two most important factors in modifying structure, is seen producing great similarity of internal organs, under variable external form. The adaptive characters are also very apparent in the raptorial fore-legs, the beak, the sucking pharynx, the respiratory siphon and in many other structures. The general principles of their physiology is the same as that of the vertebrates. There is the same conflict between waste and repair, the identical processes of changing food into muscle and nerve, the same general chemistry of respiration, etc., etc. They are not endowed with mind, but possess sufficient nervous sense to meet their requirements, and,

although built on a simpler plan, are as distinctly physiological machines as are all vertebrates.

DESCRIPTION OF PLATES IX, X, XI, XII.

FIG. 1.—Head of Belostoma larva seen from above, dissected so as to show the cephalic glands. In front is seen the beak with the sheath and bristles withdrawn, and the bristles pushed to the left.

FIG. 2.—Side view of beak and portion of head of Perthostoma, with pumping apparatus and one cephalic gland attached. In this case the sheath extends into the beak, as is natural. The bristles are not shown.

FIG. 2 *a*.—View from above of the cephalic gland of adult Belostoma, × about 20 diameters.

FIG. 3.—Digestive apparatus of Ranatra (×$\frac{3}{4}$). The Malpighian tubes are represented in part only, portions having been removed in dissecting.

FIG. 4.—Heart of adult Belostoma (× 2), showing triangular muscles, the different chambers of the heart and the afferent openings. Some of the muscular fibers should be represented as crossing above the heart. Anterior to the muscles on the left is seen the triangular attachment of connective tissue.

FIG. 5.—Digestive apparatus of Belostoma (× 2). The salivary glands and the ilium are represented as *too wide*. Part of the Malpighian tubes were removed before the drawing was made.

FIG. 6.—Portion of the head of Belostoma with the sheath and the pumping apparatus attached (magnified at least twenty diameters). The œsophagus enters the pumping apparatus from the left. The oblique lines represent the chitinous threads for muscular attachments.

FIG. 7.—Cross-section of the pumping apparatus (magnified as above).

FIG. 8.—Female generative apparatus, extended and spread, from a large specimen of Belostoma (× 2). Compare with Fig. 14 *a*.

FIG. 9.—Female generative apparatus of Ranatra (× 3). Three tubes of each ovary in sight. Below is seen the cæcum and a part of the intestine pushed to the right.

FIG. 10.—Male generative apparatus of Ranatra (× 3). On the right is seen the elongated sac in which the spermiferous tubes are matted; on the left the sac is removed and the tubes spread out. The vas deferens, at first thread like, enlarges and coils upon itself several times before emptying into the ductus ejaculatorius.

FIG. 11.—Male organ of intromission, Belostoma, considerably enlarged. Drawn with the camera lucida.

FIG. 12.—Male generative apparatus of Belostoma (× 2). Membranous sac rounded, thin, showing tubes within; on the left the sac is removed and the tubes spread as in Fig. 10. Vas deferens not coiled.

FIG. 13.—Side view of genito-anal prolongation, one seta removed, and the penis elevated to the right. On the side of the genital prolongation is seen the copulatory hook.

FIG. 14.—Genito-anal prolongation and caudal setæ, front view.

FIG. 14 *a*.—Female generative apparatus of Belostoma (× $\frac{3}{4}$), showing the flexure of the ovaries and immature ova in their upper part.

FIG. 15.—Portion of brain and optic nerves of Belostoma, to show the branching at the extremities of the optic nerves.

FIG. 16.—Cross-section of head of Belostoma from above, to show the auditory chambers and parts of the enclosed antennæ.

FIG. 17. Nervous system of Ranatra (× $\frac{3}{1}$). The branching of the nerves in the abdomen partly diagrammatic.

FIG. 18.—Antennæ of Belostoma.

FIG. 19.—Antennæ of Perthostoma.

FIG. 20.—Antennæ of Ranatra. The last three figures from camera lucida sketches.

FIG. 21.—Cross-section of pumping apparatus, showing how the muscles are attached to the chitinous threads, and how they divide into two sheets as they pass upwards.

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TOPOGRAPHICAL PHENOMENA IN INDIANA.

BY JOHN T. CAMPBELL.

ABOUT fifteen years ago I was engaged in helping to make several surveys in Western Indiana and Eastern Illinois for railroad purposes. In such work one is apt to notice topography sharply. While thus employed I observed that the hills along all the east-west flowing streams on the up or table-lands were steep and abrupt facing northward, and on the opposite side, facing southward, they were gentle slopes. This was true throughout the glacial drift region. As the streams in nearing the Wabash river wore down below the drift, the slopes reversed, and the steepest hills faced the south, but the difference in slope is not nearly so noticeable as the opposite in the drift.

At the time I first observed this peculiarity of slope, I had read no work on geology, and had but a very limited idea of dynamical geology, derived from a meager recollection of a few lectures on the subject, heard several years before. I supposed these phenomena were not only observed and described, but accounted for. In my subsequent reading on the subjects which ought to cover this, I have been not a little surprised to find that these *facts* have not only *not* been accounted for, but not *observed*. After my failure to find it where I expected, I inquired of men eminent for their knowledge of such subjects as should include this, and have found that not one out of nine seemed to have observed or heard of the phenomena, and several even expressed a doubt of the existence of the facts.

During my subsequent readings and inquiries, I have greatly

extended my observations and investigations of the subject, and confidently believe that I am offering something new in what follows for the consideration of the scientist and philosopher.

In the month of May, 1881, I was employed on a railroad survey from Indianapolis, Indiana, to a point on the Ohio river. Nearly all this time was spent in preliminary lines in Brown county, about fifty miles south of Indianapolis, to find a practicable line across the several high ridges running east and west across this county. These ridges, according to Dr. John Collett, State geologist, headed off the glacial drift from this place. Certain it is there is no glacial drift south of the first or most northern ridge, though both east and west of these ridges the drift extends nearly to the Ohio river, and beyond it on the east side of the State. These hills or ridges look like small mountains, but they are only hills, there being no upheavals. The strata can be traced through all the ridges. These hills are composed almost entirely of Waverly sandstone, or knob-stone, as Indiana geologists call it. Valleys have been eroded over 400 feet deep, by small west flowing streams. The stone dissolves easily on exposure to the weather, hence the great amount of erosion by the small streams, much greater than the same water-shed shows in any other part of the State.

In this region the steep hills face the south, though the difference between opposite slopes is not half so great as in the drift regions to the north.

In the glacial drift region, especially on the high or table-land where the stream valleys are shallow, the east-west flowing streams lay up close against the foot of the hills on the south side, and these hills are often as steep as a precipice, while on the north side (facing southward) they are often not over twenty degrees from a horizontal.

In this region the trees growing on the south-facing hillsides lean down hill much more than do those on the much steeper north-facing hills, or on the steeper east and west facing hills.

In Brown county, before mentioned, I could not discover any difference in the lean of the trees on the hillsides. The soil on these east-west ridges is composed of the decomposed sandstone before mentioned, and is very thin, especially on the hillsides. In this region the streams wash against the north hills (facing southward) noticeably more than the south side (facing northward, the

reverse of what is so plainly seen in the glacial drift region a few miles to the north.

Another fact of much importance, and quite as striking as the slope of the hills, is that in the large creek and the river bottoms the trees lean down stream, regardless of direction; that is to say, they lean in the direction of the flow of the water which deposited the ground on which they stand. In every case I have examined (I think several hundred), wherever the trees lean up the general course of the stream, there is found the trace of an ancient bend of the channel, turning back up itself for a short distance and abandoned on account of a subsequent cut-off. This tendency of the trees to lean down stream (where the flood deposit is six feet or more) is the same in the drift region and south of it where I have observed, and I presume it is in obedience to a law that is general over the world. At the upper end of the bottoms, where the deposit is old, the leaning tendency decreases, and is greatest at the lower end in the most recent deposits.

In this age it is not easy or comfortable to merely accept these facts and ask no questions. This problem-solving age *will* ask, What law is at work that makes all the north-facing hills from, Indianapolis west to the State line steep, and the south-facing gentle, while in Brown and the east part of Monroe counties, the steep hills face southward and the more gentle northward? The same clouds have rained on both localities; the same cold winds have frozen, and the same sun and warm winds have thawed both localities. The weather effects on topography would not change in the short space of ten miles; but we find a change as soon as we pass south of the southern terminus of the drift.

I offer an explanation of these phenomena for consideration and criticism, but wish to say here, that being aware of my limited knowledge on such subjects, I have submitted my facts and views to as many eminent geologists as I could reach, and sought their opinions. All have signified that this feature of the subject is new. Several have strongly denied my deductions; others have doubted the facts, while still others have given an agnostic shake of their heads—"We don't know." None have offered a better explanation, and my diligent search has found nothing to contradict my theory. As I have no scientific reputation to lose, I can afford to be the little elephant that tries the depth and swiftness of the waters.

The explanation I would suggest is, that sedimentary deposits from running water have always a tendency to move or slide in the direction of the flow of the water making the deposit, and this sliding tendency is in proportion to the swiftness of the water.

I assume that if a trench should be cut across the flood plain of a river at right angles to the current that made the deposit, and as deep as the bed of the river, the up-stream side would in no long time assume a slope of low inclination, while the down-stream side would remain steep, and drop down in falls whenever any change should take place.

Big Raccoon creek, a stream 200 feet wide, enters the Wabash river from the east in this (Parke) county, and flows westward across the Wabash bottoms for one and a half miles. The banks are twelve to twenty feet high, and those on the up-stream side (of the Wabash current) are easy slopes which a foot-man can easily descend to the water's edge, while all the way across the bottom, the opposite down-stream, or south side (facing northward), is like a continuous precipice. The trees growing along the north bank stand from the top of the bank well down to the water's edge, lean down hill from ten to forty degrees, while on the south side they stand erect till so far undermined that they fall into the stream. The current persistently beats against the left or south bank all the way across the Wabash bottom, the same as in the upland drift.

In this country the roads are mostly laid on the section lines, causing nearly all of them to run due north, south, east and west. This takes them over ridges and down and up steep hills, requiring deep cuts and heavy fills. These cuts, where they are through the glacial drift deposit, show the same condition as the creek banks before mentioned, the south-facing side of the cut has the gentlest slope. The water flowing down the gutters at each side of the roadway bear most against the south bank (facing north). The north bank (facing southward) shows much the greatest apparent plasticity, or mobility, to quietly slide down like soft paste and reform the gentle slope, while the opposite side drops down in falls like soft sandstone would be expected to do. I have noticed that the little blocks or cubes into which the drift clay separates in time of drought, have a dip southward in the line of their "season cracks," as we may call it. During protracted

rains the water percolates through these cracks, rendering the cubes soft and slimy, and aiding the plastic slide in the direction of the dip of the cube cracks—southward.

In support of the theory I advance—well, call it speculation—I submit the following facts: If a lump of putty, say twenty-five pounds, with a consistency that would maintain its shape, should have a number of small sticks or common matches stuck into it in an erect position, as shown by the dotted line in Fig. 1, these would represent trees growing on a hillside. If one side of this putty should be exposed to the heat of the sun or a fire, its consistency would be reduced and it would slide as shown by the solid line in Fig. 1, and the matches (trees) would lean down hill.

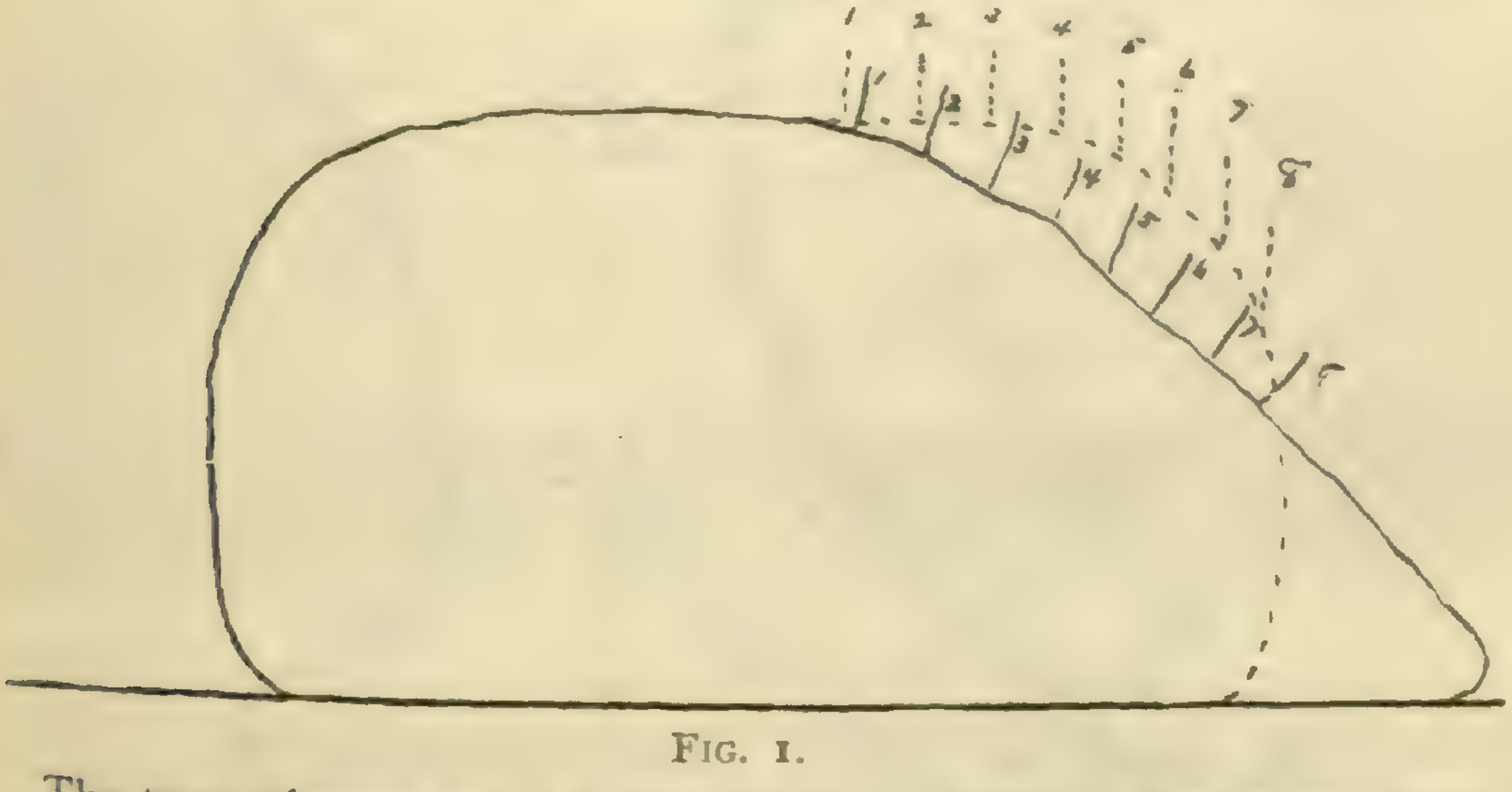

FIG. 1.

The trees always grow vertical unless inclined by some exterior force. On hillsides we find the young trees growing vertically, inclining down hill with age, the oldest inclining most. Without doubt the old trees started in life with good intentions, and tried to grow with the plumb line. When a tree is suddenly inclined as much as forty-five degrees, it will send out saplings from the upper side of its trunk. See tree *h* in Fig. 2, which figure illustrates the different slope of north and south-facing hills in the glacial drift, and the lean of the trees thereon.

Fig. 3 shows the profile of a railroad survey north and south, and crossing east or west streams and ravines in the drift region.

Fig. 4 shows the lean the trees would take at the bends in a river bottom as indicated by the arrows, and the slope of the hills on the north and south side of east and west flowing streams and ravines in the drift region.

As proof that the slope of the hills is not due to the surface

FIG. 2.

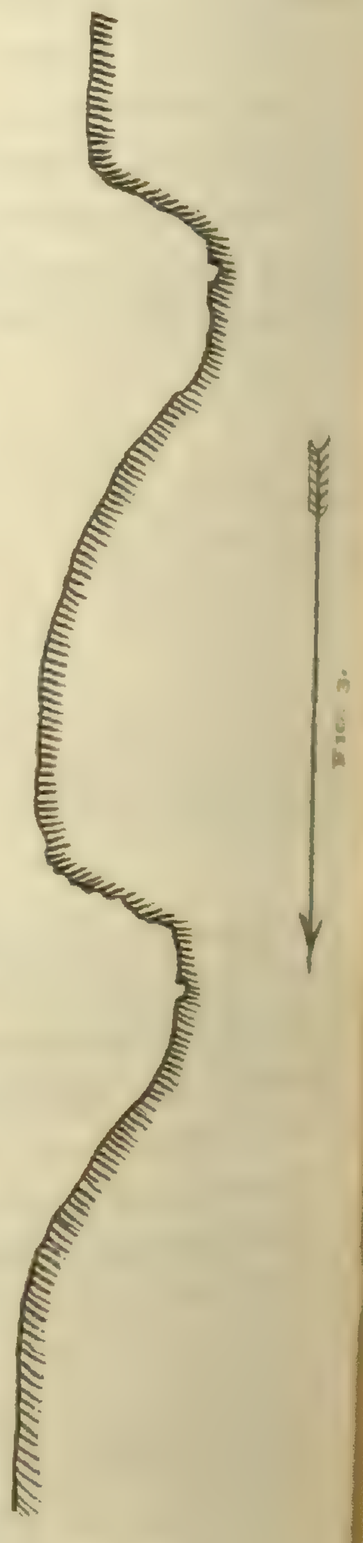

FIG. 3.

washing, or action of frost, we find the roots of the oldest trees about equally exposed at the top, side and foot of the hills

whereas, if it was a surface movement, the roots would become bare at the hill top, and covered at the hill's foot, as shown in Fig. 5.

Where this is the case, as it sometimes is, the dotted line represents the surface when the trees began life, and the solid line the surface after rain washings.

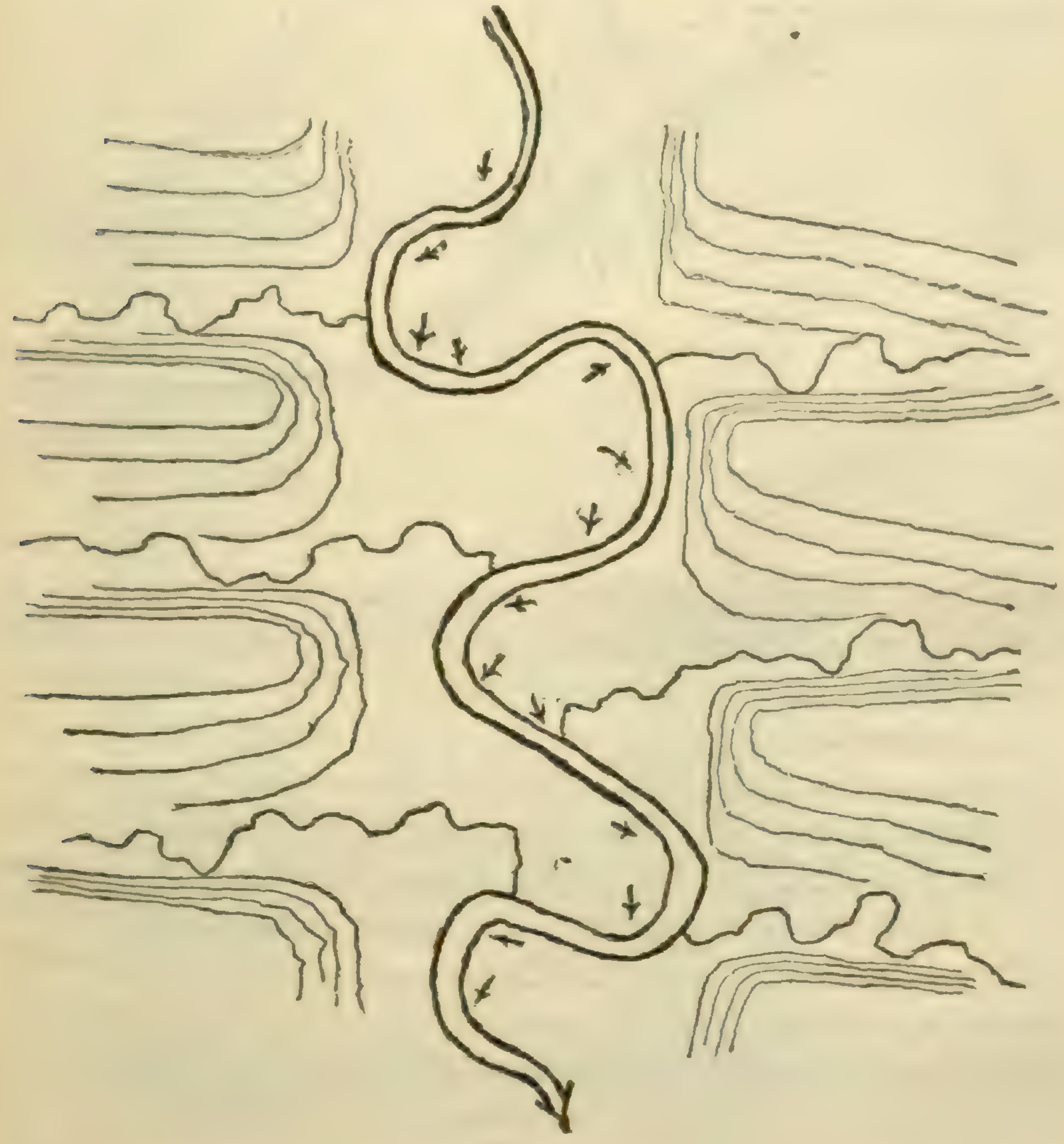

FIG. 4.

The first explanation of the less inclined south-facing hill in the drift is apt to be the lateral push of freezing. That the sun thawing out the south-facing hill so much oftener than the opposite, to be refrozen, gives it the greatest motion. A little reflection will explode this answer. The greatest number of thaws in real winter are due to warm winds and warm rains, when there will be no sunshine. These will affect both hills alike; beside the major part of every thaw comes from beneath and would affect both hills alike. I have seen too much power attributed to the

lateral push of freezing. A careful analysis of its process will show that it can have but little lateral push on level, or even much

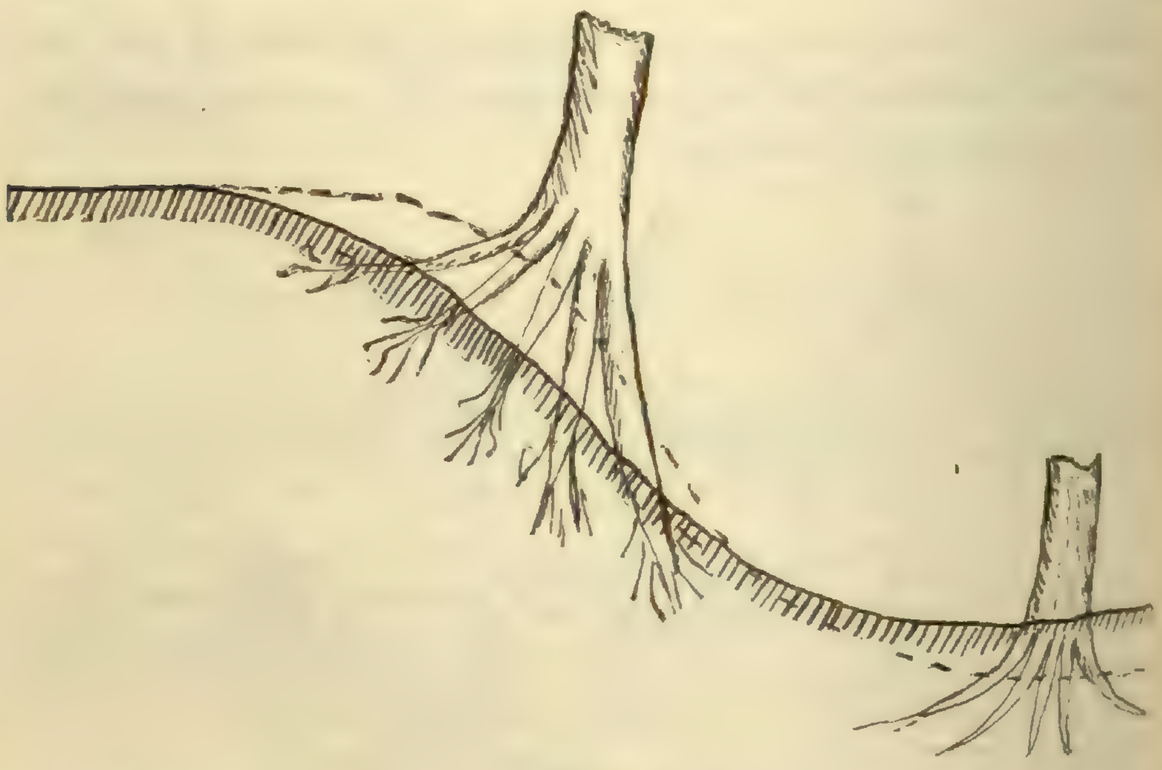

FIG. 5.

on inclined ground. The first freeze is a thin crust on top, not thicker than paper (and about as powerless as paper), which thickens downward as the freeze goes on. The next thickness of freeze below adds nothing to the lateral force of the first, nor does the next, and the next. The only force freezing exerts on the ground is an uplift. There are no cracks in frozen ground as we find in thick ice, which clearly shows that the very doubtful fact of *much* lateral expansion in the under freeze of ice does not apply at all to frozen ground. Cellar and other walls are often pushed in by freezing for the plainest reason. The freeze begins on the face of the wall, extends back through it to the ground, so that the uplift, *a b* in Fig. 6, becomes a side push, *b c*.

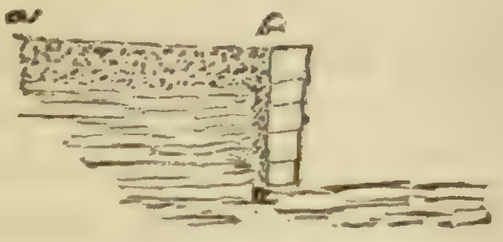

FIG. 6.

This inpush from a freeze never occurs where a cellar is kept warm, but the retain or guard wall of an outside stairway, and other outdoor walls, are often thus pushed. I am fully satisfied that the different slopes of the north and south facing hills is not

due to surface washing or the unequal lateral pressure of freezing.

I have made frequent inquiry of railroad section men, who all

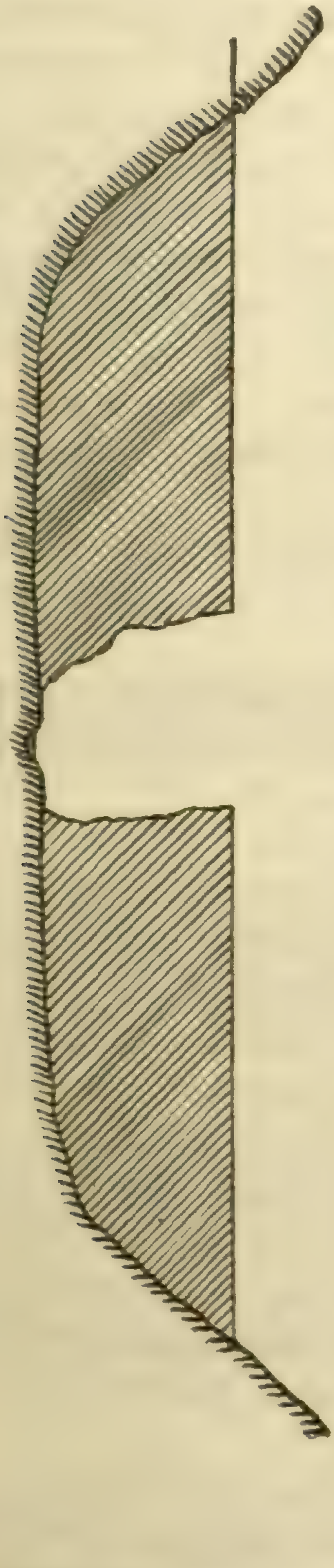

FIG. 8.

FIG. 7.

tell me that the north side of an east-west railroad embankment washes during rains and slides more than the south side; but the east-west cuts show the same phenomenon as the hills. As they

are constantly repaired the passer-by cannot see the natural effect, but section men say that the ditch on the north side of the cut fills much oftener than the other. Why does a railroad embankment slide one way, while the cut out of which it was taken slides the other? Because they were built by different processes.

Farmers in this country know that when they thresh their grain and stack the straw by carrying it forward from the thresher and throwing it over the forward or outer end of the stack, it will continue for months to slide in that direction, though it would be hard to detect the oblique stratification in the build of the stack.

If a railroad embankment should be built across a valley, with excavations from the adjacent hill carried and poured over the forward end of the embankment till completed, it would be in fact as it appears in Fig. 7, except that the eye could not detect the oblique stratification unless it was due to a change in the color or quality of the earth.

If, after this bank had become well settled, a "washout" should occur, carrying away the culvert, *c* Fig. 7, it would leave two walls standing, as shown in Fig. 8.

The earth is obtained from an excavation at the left and carried to the right, so that the oblique stratification will dip to the right, as shown in Figs. 7 and 8. The bank on the right side of the "washout" would have to break across the line of the oblique stratification, hence it would project, or "overhang," as a precipice, while the opposite side would break more with these strata, would be inclined to slope, as illustrated in Fig. 8.

In the course of a year or so the right bank would break and drop down in falls, and the left would gradually and imperceptibly slide like soft putty, and form a slope as shown in Fig. 9.

Where a bank is built by pouring the earth over the end or side, it will continue to slide in that direction long afterward. I think every engineer of much experience will agree to this. The bank, as shown in Fig. 9, shows the same condition we find in the north and south-facing hills in the drift region, the left side representing the south-facing hill.

Flood plains, or bottoms of streams are deposited in this order. The bars at their up-stream ends are level with low water, and even extend up stream under the water, while at their down-stream end they are elevated as high as the older bottom land, a part of which they ultimately become. The swiftest current is at this

upper end of these bars, consequently only the heaviest pebbles

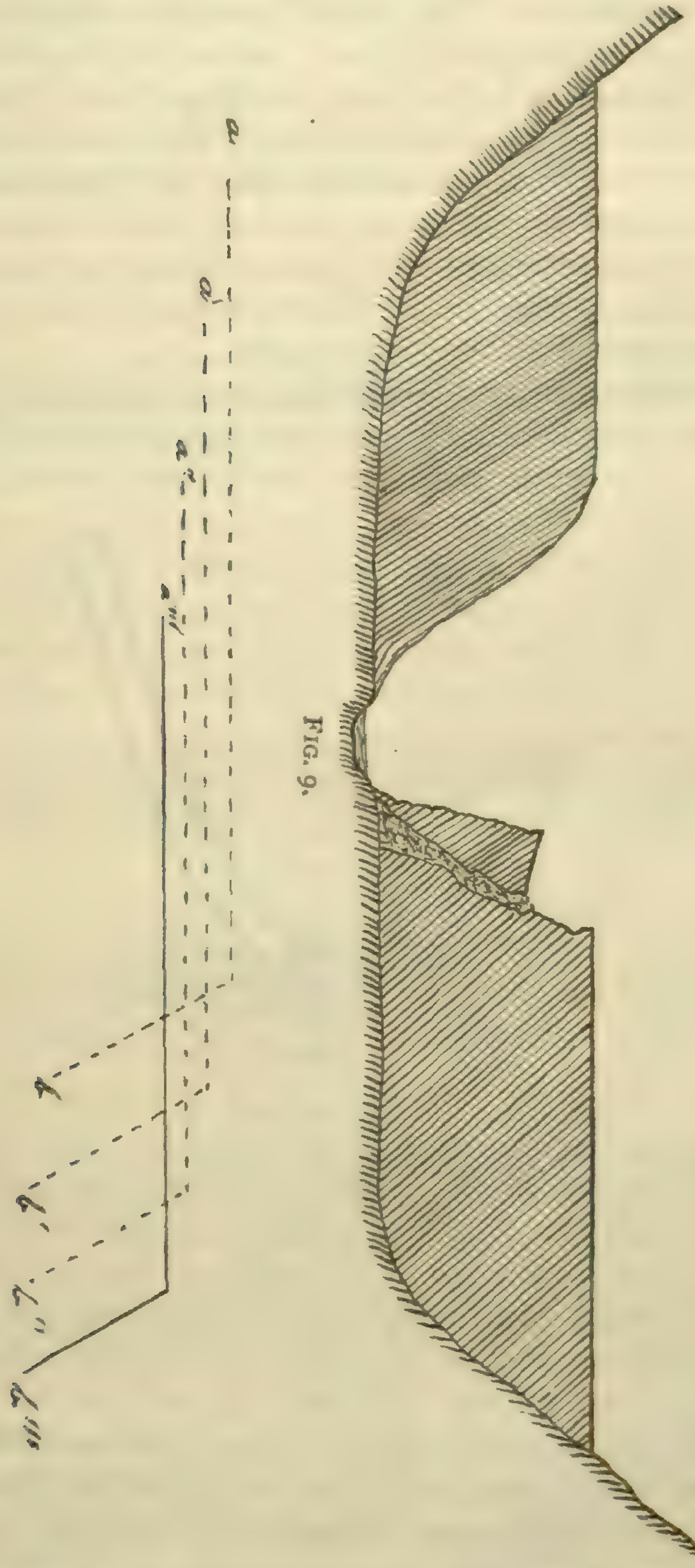

FIG. 9.

FIG. 10.

are dropped there; the next heaviest being dropped next farther down, and so on to the lower end where the bars always termi-

nate in fine sand, with a pour over the end as shown in the railroad embankment in Figs. 7 and 8, and more definitely in Fig. 10.

In Fig. 10 the dotted line, *a b*, shows the longitudinal section of the bar, as left by the last preceding flood. The line, *a' b'*, shows it as left by the next succeeding flood, and the lines *a'' b''* and *a''' b'''* show the conditions after still later floods. Hence bars and bottoms are always building down stream and being worn away at their up-stream ends. While they are, in *fact*, deposited in an oblique order, it is rarely that the eye can detect it in a longitudinal section of the bottom.

A bottom built in this order would be expected to have a sliding tendency like the straw stacks and railroad banks before mentioned. The fact that the trees which grow thickly over the bar

FIG. 11.

over *b b' b''* and *b'''*, at first grow with the plumb line, and begin to lean down stream with age till the grown ones lean from ten to forty degrees, is clear proof to me that the newly deposited bottoms slide like a glacier, obeying the same law of motion, but greatly slower of course. The surface moving faster than the bottom, would incline the trees. If the bottom (flood plain) should slide one foot in fifty years, it would be sufficient to produce the result we see. The trees do not get their inclination from the pressure of the floods. These bottom trees grow rapidly, and in ten years are able to withstand the floods. Besides the current is always weak at the lower end of the bars. Eddies generally prevail there, otherwise there would be no sediment dropped.

When a growing tree is bent or inclined, it makes an effort to

grow vertical from that time (and point) upward, and at maturity shows the curve and tangent as in Fig. 11.

Nearly all the trees growing on the down-stream end of bottoms, show the lean as in Fig. 11, and some show the bend at the bottom. The young trees, at ten years, show very little inclination as compared with the grown and old ones.

I saw a case in the north-east part of Brown county, before mentioned, on the south side of Jesse Walker's farm (section, township and range forgotten), where a "worm" rail fence had been built on the south boundary line across the bottom of a small stream or brook, the bottom not over 300 feet across. The fence had been built straight, and about eight rails high. The sediment carried from the fields on the adjacent hills during rains, was caught by the grass and so silted up that the bottom rails were submerged. The proprietor kept adding rails to the top as fast as they were submerged at the bottom, so as to keep the necessary height of fence. This continued about fifteen years, when the original eight rails had been entirely covered or submerged, when it was noticed that the fence had been swayed down stream about four to five feet from the original straight line. The sedimentary deposit had certainly moved like a glacier. This coincides with the other facts before stated.

In conclusion, the drift was deposited here by the waters from a receding glacier. The general course of the flow, as indicated by the striations, was about south 15° to 18° west. If my theory is correct, the tendency of the deposit of the drift would be to slide southward. I do not wish to be understood as confidently affirming the correctness of my theory, but that the slope of the hills, the lean of the trees on south-facing hills, taken in connection with the other facts I have cited, strongly suggest my theory as the explanation of the facts. If this theory does not explain the phenomena, what other does? Are there any well-established facts which contradict this theory? If so—what?

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RENUMERATION OF THE SPINAL NERVES AND RECONSTRUCTION OF THE PLEXUSES IN THE HUMAN SUBJECT.

BY DR. ELLIOTT COUES.

THERE being a pair of spinal nerves to each vertebral interspace down to the coccyx, and the pair counted first being

above the first cervical vertebra (between atlas and occiput), it obviously follows that the seventh cervical pair is above the seventh cervical vertebra. There being but seven cervical vertebræ "eight cervical nerves" cannot properly be said. For the nerve enumerated and known as "eighth cervical," issuing as it does *above* the first dorsal vertebra, is actually first dorsal, according to the count we start with.

If we agree in the beginning to number and name spinal nerves by the number and name of the vertebra next *below* each one of them, then to reckon eight cervical nerves to seven cervical vertebræ sets the whole series of succeeding nerves wrong by one. The irregularity is obvious, requiring no comment; but how it was brought about is not explained in the ordinary text-books, and the student learns the plexuses with difficulty, instead of with the ease with which he can be taught to know them if the nerves which enter into their composition be counted correctly. Sufficiently complicated as it is at best, the matter may nevertheless be much simplified by a fair count.

The case affords a curious instance of survival of the *unfittest* —a singular oversight of early anatomists having been perpetuated to the present day, and become ingrained in the established numbering and naming of the spinal nerves as grouped into cervical, dorsal, lumbar, sacral and coccygeal sets. It arose in this way: When the cranial and spinal nerves were numbered, the true first spinal (suboccipital, between occiput and atlas) was reckoned a *cranial* nerve; then that one which issues *below* the atlas (between atlas and axis) of course became "first cervical," and succeeding ones were numbered consecutively, that one which issues *below* the seventh cervical vertebra being of course "seventh cervical." Next, when the cranial nerves were revised, the suboccipital was correctly excluded from the cranial set and included in the spinal series, being added of course to the cervical nerves. Thus there then came to be "eight cervical" nerves, for the same lower limit of the "cervical" series was retained. But their collective number and their respective numbers being each raised by one nerve, it was as if their respective positions had each dropped down one vertebra; so that, for example, what had before been seventh and last cervical nerve became then "eighth" and last (between last cervical and first dorsal vertebra). Strangely enough, however, the other spinal nerves were left as

they had been before, the renumeration required to shift the several sets into proper position not having been made. Hence arose that irregularity which has doubtless tried the wits of many a student, puzzled to discover how there can be reckoned *eight* cervical nerves to *seven* cervical vertebræ, though there is one nerve apiece to the dorsal, lumbar and sacral vertebræ, and yet no break in the whole series; how it can be that the first cervical nerve issues *above* the first cervical vertebra, yet the last cercal nerve issues *below* the last cervical vertebra; how it can be a *second* cervical nerve which issues between the first and second cervical vertebræ, yet a "*first* dorsal" which issues between the first and second dorsal vertebræ; and so forth. There is evidently something wrong about this; yet it has become so thoroughly ingrained in our nomenclature and descriptions of these nerves, that a very poor piece of arithmetic somehow looks like a necessary anatomical fact.

The required correction is self-evident, and wrong numbering is very easily rectified. To make the count straight we have only to do for the dorsal, lumbar, sacral and coccygeal nerves what was done for the cervical when the suboccipital was added to that series—drop them all down one vertebra or, what is the same thing, raise them all up one number.[1] Just as what had been in the first place first cervical nerve has now become second cervical, and what had been seventh cervical nerve became eighth cervical; so now, what has hitherto been eighth cervical nerve (8th of the whole series) becomes first dorsal; what has been twelfth dorsal (20th of the whole series) becomes first lumbar; what has been fifth lumbar (25th of the whole series) becomes first sacral; what has been fifth sacral (30th of the whole series) becomes first coccygeal, and what has been first and last coccygeal (31st of the series) becomes second and last coccygeal (see table at end). Of course neither the total of the spinal nerves (31), nor the several sums of the sets of dorsals (12), lumbars (5) and sacrals (5) is altered; but there are seven instead of eight to be reckoned cervicals, and two coccygeals instead of one; and the boundaries of each of the sets shifts up one vertebra. By this simple rectification every spinal nerve is regularly numbered and named by the vertebra *above* which it issues (since

[1] A nerve is *raised* numerically when, *e.g.*, a sixth becomes a seventh; but it is then *lowered* in position.

we begin that way), instead of being reckoned irregularly, sometimes by the vertebra above it, sometimes by the vertebra below it; and the sets of nerves are all brought into uniform relation with the sets of vertebræ, from occiput down to coccyx. The difference between the reckoning hitherto in vogue and that now proposed may be easily brought to the eye. In the following examples of old and new styles the letters are the vertebræ, the lower figures being their own numbers, but the upper figures are the numbers of the nerves; thus $^{8}d_{1}$ is first dorsal vertebra and so-called eighth cervical nerve. It will be seen that in the first row no numbers correspond with those of vertebræ after $^{7}c_{7}$, and that in the second row all the numbers correspond as long as nerves hold out. It will also be seen that the lumbar and sacral plexuses are out of order with their respective vertebræ in the first row; and that in the second row the change in numeration brings these plexuses into order with their respective vertebræ (the composition of plexuses being of course the same in either case):

cv. plex. brach. plex. intercostal nerves.

Old style—$^{1}c_{1}, ^{2}c_{2}, ^{3}c_{3}, ^{4}c_{4}, ^{5}c_{5}, ^{6}c_{6}, ^{7}c_{7}$; $^{8}d_{1}, ^{1}d_{2}, ^{2}d_{3}, ^{3}d_{4}, ^{4}d_{5}, ^{5}d_{6}, ^{6}d_{7}, ^{7}d_{8}, ^{8}d_{9}, ^{9}d_{10}, ^{10}d_{11}, ^{11}d_{12}$;

New style—$^{1}c_{1}, ^{2}c_{2}, ^{3}c_{3}, ^{4}c_{4}, ^{5}c_{5}, ^{6}c_{6}, ^{7}c_{7}$; $^{1}d_{1}, ^{2}d_{2}, ^{3}d_{3}, ^{4}d_{4}, ^{5}d_{5}, ^{6}d_{6}, ^{7}d_{7}, ^{8}d_{8}, ^{9}d_{9}, ^{10}d_{10}, ^{11}d_{11}, ^{12}d_{12}$;

cv. plex. brach. plex. intercostal nerves.

lumb. plex. sacr. plex.

$^{12}]_{1}, ^{1}]_{2}, ^{2}]_{3}, ^{3}]_{4}, ^{4}]_{5}$; $^{5}s_{1}, ^{1}s_{2}, ^{2}s_{3}, ^{3}s_{4}, ^{4}s_{5}$; $^{5}c_{1}, ^{1}c_{2}, ^{0}c_{3}, ^{0}c_{4}$.

$^{1}]_{1}, ^{2}]_{2}, ^{3}]_{3}, ^{4}]_{4}, ^{5}]_{5}$; $^{1}s_{1}, ^{2}s_{2}, ^{3}s_{3}, ^{4}s_{4}, ^{5}s_{5}$; $^{1}c_{1}, ^{2}c_{2}, ^{0}c_{3}, ^{0}c_{4}$.

lumb. plex. sacr. plex.

It is incumbent upon one who proposes innovations to show good reason for interfering with established usages. In the present case it will be found, on sufficient examination, that not only is the numeration of the spinal nerves properly regulated, so that the several sets of nerves coincide with the sets of vertebræ, but also that the construction of the plexuses may be much more easily appreciated and much more simply described after than before this rectification is made. Moreover, without altering the recognized limits and composition of the plexuses in the least particular, we make them seem much more naturally constructed by simply correcting the numeration of their respective nerves.

Furthermore, the proposed rectification is equally available for other animals than man; and in these it is highly desirable to

have some fixed method of counting nerves, especially those which compose plexuses, with reference to their distribution in cervical, dorsal and other sets. If we agree to know and name any spinal nerve *by the vertebra above which it issues*, we can hardly go astray.

The principal points touching the plexuses of the human subject may be noted in comparing the old with the new style.

1. The cervical plexus is not affected (first four cervical nerves).

2. The brachial plexus falls between the cervical and dorsal sets of nerves in either case, but there is a distinction in favor of the new numeration. The plexus is said to be formed by the last four cervical (5th–8th) and first (1st) dorsal nerves; and it is said that three of the cervical (5th–7th) unite to form the upper cord, while the last (8th) cervical and first (1st) dorsal unite to form the lower cord. I should say that the brachial plexus is formed by the last three (5th–7th) cervicals and first two (1st–2d) dorsals, the former uniting in one cord, the latter in another. Thus the remarkable partition of the brachial plexus into two cords, which extend to the axilla, coincides with its derivation from the two sets of nerves; and further details, such as the union of the two dorsals as soon as they leave their respective foramina, show that the division of the two sets of nerves here made is the natural one.

3. The so-called last (12th) dorsal or intercostal nerve (that issuing between the last dorsal and first lumbar vertebra) is generally noted in the text-books for various peculiarities which relate it to the lumbar series, besides its actual connection with the latter. This nerve is really first (1st) lumbar. The lumbar plexus is variously described as consisting of the last dorsal (12th) and four (1st–4th) or five lumbar nerves (1st–5th), according to whether or not its sacral connection is taken into account. I should say simply that the lumbar plexus is formed by the five lumbar nerves proper (1st–5th), with communicating loop to the sacral plexus. Matters are here greatly simplified by the renumeration. It is well to remember that *all* contiguous plexuses have a communicating loop, both above and below; thus there is one between the cervical and brachial, and one between the lumbar and sacral; but such loops separate plexuses as well as connect them.

4. Another good effect of the renumeration is, that the great nerve called fifth lumbar, issuing between the last lumbar and first sacral vertebræ, and so remarkably distinguished from the rest in size and disposition that is already known as the "lumbo-sacral cord," is taken out of the lumbar series altogether and put where it belongs, in the sacral series, as first sacral. The sacral plexus is commonly said to be formed by the lumbo-sacral cord (5th lumbar) and the four upper sacral nerves (1st–4th) which issue from the completed anterior sacral foramina, or by these and the next nerve below. I should say simply that the sacral plexus is formed by the five (1st-5th) sacral nerves proper. There is of course the loop of communication with the lumbar, as above said, and there is also connection with the coccygeal nerve or nerves; but these are not to be taken into account in defining the plexus. The natural division of this very large but comparatively simple plexus is not into a lumbo-sacral cord (1st sacral) *and* four (2d–5th) sacral nerves, but into the four great upper nerves (1st–4th sacral proper) and the much smaller (5th sacral one.

5. The remaining very diminutive nerves are connected with the preceding. There being no inter-coccygeal foramina, they are obliged to appear together between the sacrum and coccyx. Nor are they constant in appearing. It is scarcely material whether we consider them merely tributary to the great sacral plexus, or together forming a little coccygeal plexus. I believe it is customary to take them into the sacral plexus, in which case this great plexus is made up of four large cords and two little ones, and a single coccygeal is left alone. The chief point is here, that any nerve or nerves issuing between the sacrum and coccyx must be coccygeal, whether there be one or two, and whatever disposition be made of it or them.

To strip the subject of verbiage as far as possible, I have spoken of the plexuses as formed by the nerves. It is of course understood that I mean their anterior branches in every case. Intercommunications between posterior branches of spinal nerves are not generally treated as plexuses, unless it be those between the 1st–3d cervicals, which some writers formally recognize by such name. The same may be said of connections between cranial and spinal nerves, as that of the hypoglossal. Nor are any of the sympathetic plexuses here brought into question.

It remains to formally tabulate the renumeration of spinal nerves and the reconstruction of the plexuses which I recommend for adoption :

			OLD STYLE.		NEW STYLE.		
Plexus, Cervical [Four]			N. Cervical First.	1	1. First Cervical N.	Cervical Plexus [Four]	
			" " Second.	2	2. Second " "		
			" " Third.	3	3. Third " "		
			" " Fourth.	4	4. Fourth " "		
Plexus, Brachial [Five]	[cord, upper]		" " Fifth.	5	5. Fifth " "	[upper cord]	Brachial Plexus [Five]
			" " Sixth.	6	6. Sixth " "		
			" " Seventh.	7	7. Seventh " "		
	[cord, lower]		" " Eighth.	8	8. First Dorsal N.	[lower cord]	
			N. Dorsal First.	9	9. Second " "		
Intercostals [Ten]			" " Second.	10	10. Third " "	Intercostals. [Ten]	
			" " Third.	11	11. Fourth " "		
			" " Fourth.	12	12. Fifth " "		
			" " Fifth.	13	13. Sixth " "		
			" " Sixth.	14	14. Seventh " "		
			" " Seventh.	15	15. Eighth " "		
			" " Eighth.	16	16. Ninth " "		
			" " Ninth.	17	17. Tenth " "		
			" " Tenth.	18	18. Eleventh " "		
			" " Eleventh.	19	19. Twelfth " "		
			" " Twelfth.	20	20. First Lumbar N.		
Plexus, Lumbar [Five]			N. Lumbar First.	21	21. Second " "	Lumbar Plexus. [Five]	
			" " Second.	22	22. Third " "		
			" " Third.	23	23. Fourth " "		
			" " Fourth.	24	24. Fifth " "		
Plexus, Sacral	[Lumbo-sacral cord]		" " Fifth.	25	25. First Sacral N.	large	Sacral Plexus [Five]
	large		N. Sacral First.	26	26. Second " "		
			" " Second.	27	27. Third " "		
			" " Third.	28	28. Fourth " "		
	small		" " Fourth.	29	29. Fifth " "	small	
			" " Fifth.	30	30. First Coccyg. N.		
			N. Coccyg. First.	31	31. Second " "		

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A REVIEW OF THE PROGRESS OF NORTH AMERICAN INVERTEBRATE PALÆONTOLOGY FOR 1883.

BY J. B. MARCOU.

I HAVE taken up the task of preparing this brief review at the request of Dr. C. A. White, who, for several years past, has prepared a similar one, but whose numerous avocations do not leave sufficient time for continuing his publication of such a review.

During the latter part of the year invertebrate palæontology

has lost two of its most eminent students, Professor Oswald Heer, of Zurich, whose descriptions of the cretaceous dicotyledons of Nebraska and of the arctic flora, assure him a prominent place among the pioneers of American palæontology; and Mr. Joachim Barrande, whose publications of a number of our older fossils also entitle him to a prominent place in the history of the progress of North American palæontology.

At the meeting of the American Association for the Advancement of Science for 1883, a number of palæontological papers were read, of which brief notices appeared in *Science*, Vol. II, No. 31. Professor James Hall read a paper entitled "Preliminary note on the microscopic shell structure of the paleozoic Brachiopoda." Professor J. W. Dawson read a paper on "Rhizocarps in the paleozoic period." Mr. E. W. Claypole read a paper on "Rensellæria and a fossil fish from the Hamilton group of Pennsylvania," he also read a paper on "A large crustacean from the Catskill group of Pennsylvania."

H. Booth, in the *American Journal of Science*, for November has a note on the "Discovery of Utica slate Graptolites on the west side of the Hudson."

S. Calvin, in the *Amer. Journ. of Science*, for June, published an article "On the fauna found at Lime creek, Iowa, and its relation to other geological faunas." In this article he points out a few errors made by Professor H. S. Williams, in the *Amer. Journ. of Science*, for February, on "The fauna at the base of the Chemung group, in New York." Mr. Calvin, while admitting the similarity of the Lime creek fauna with that of High Point, N. Y. considers their equivalency very doubtful.

John M. Clarke, in the *Amer. Journ. of Science*, for February published a paper on "New discoveries in Devonian crustacea."

E. W. Claypole, in the AMERICAN NATURALIST, Vol. XVII, No. 3, published a paper "On the occurrence of fossiliferous strata in the lower Ponent (Catskill) group of Middle Pennsylvania."

J. W. Dawson, in the *Canadian Naturalist and Quarterly Journal of Science*, Vol. X, New Series, No. 7, has a "Preliminary notice of new fossils from the Lower Carboniferous limestones of Nova Scotia and Newfoundland," in which there are descriptions of six new species from Nova Scotia, and of three from Newfoundland. In No. 8, of the same paper, Professor Dawson has a "Notice of graptolites of the Quebec group, collected by Mr. James Richardson for the Peter Redpath museum." In the Trans-

of the Royal Soc. Canada, on May 23d, 1883, he presented a paper on the "Cretaceous and tertiary floras of British Columbia, and the Northwest territory," illustrated by eight quarto plates; he mentions the occurrence of a few plants from the Ft. Pierre group, which are apparently different from a flora found in the same group on the Upper Missouri by Mr. Lester F. Ward in 1883, and yet unpublished.

Walter F. Ferrier, at the fourth meeting of the Natural History Society of Montreal, session 1882–1883 (published in the *Canadian Naturalist and Quarterly Journal of Science*, Vol. x, New Series, No. 8), read his "Notes on a fossil track from the Potsdam sandstone of Northern New York State," and Dr. Dawson said that the impressions belonged to the genus *Gyrichnites*, proposed by J. F. Whiteaves for similar impressions from the Erian of Gaspé.

Wm. F. E. Gurley published his "Bulletin, No. 1, New Carboniferous Fossils;" this is a private publication, apparently printed for private circulation—the descriptions are very indifferent, and the absence of any figures renders it difficult to say whether his species are new or not. It would be well for Mr. Gurley, if he wishes his species to be recognized, to seek publication through some of the regular channels, and to accompany his descriptions with proper illustrations.

Angelo Heilprin, in the Proc. Philadelphia Acad. of Nat. Sciences, published a "Note on a collection of fossils from the Hamilton (Devonian) group of Pike Co., Pennsylvania." This is a list of species and genera identified by Professor Heilprin in a collection made by Drs. E. Hine and J. Holt, and is welcome as a contribution to our knowledge of the palæontology of a State, concerning which we know comparatively little.

Indiana.—The twelfth report of the State geologist, Mr. John Collett, contains fourteen plates of the Van Cleve fossil corals, which are on the whole very creditable productions; they were reviewed by Professor James Hall, who also republishes here fourteen plates of his own corals, most of which are referred to as having been published in the advance sheets of the thirty-fifth annual report of the New York State Museum of Natural History (which has not yet appeared), but five of the species were unpublished. The Spergen Hill Brachiopoda, published by R. P. Whitfield, in the Bulletin No. 3, of the Amer. Museum of Nat. Hist., have also been reproduced here.

Illinois.—The seventh volume of the geological survey of Illinois contains descriptions of fossil invertebrates by A. H. Worthen, and S. A. Miller, and by Chas. Wachsmuth, and W. H. Barris, illustrated by five plates, together with an article on a new genus and species of Blastoids, with observations upon the structure of the basal plates in Codaster and Pentremites by Chas. Wachsmuth, and descriptions of some new Blastoids from the Hamilton group by W. H. Barris, in which four new species are described. The crinoids described are mostly from the Lower Carboniferous, being from the Keokuk, Warsaw, Chester, and St. Louis groups, with the exception of two or three species from the Upper Carboniferous.

U. P. James, on April 16th, published the seventh number of his "Palæontologist," with illustrated descriptions of three new species of fossil corals from the Cincinnati group of Ohio and Kentucky. In the Journal of the Cincinnati Society of Natural History, Vol. VI, December, he published "Descriptions of fossils from the Cincinnati group," illustrated by one plate, No. X; only two species are described.

Leo Lesquereux, in the proceedings of the U. S. National Museum, Vol. V, pp. 443–449, has published a "Contribution to the Miocene flora of Alaska," illustrated by five plates, VI to X, containing descriptions and figures of some new species, with an enumeration of some species already described, but not yet known in the flora of Alaska.

S. A. Miller, in the *Amer. Journ. of Science*, for August, published a "Response to the remarks of Messrs. Wachsmuth and Springer on the genera Glyptocrinus and Reteocrinus." In the Journal of the Cincinnati Society of Natural History, Vol. VI, December, 1883, he published an article entitled "Glyptocrinus re-defined and restricted, Gaurocrinus, Pycnocrinus, and Comptocrinus established, and two new species described." This article is illustrated by one lithographic plate of indifferent execution.

John Mickleborough, in the Journal of the Cincinnati Society of Natural History, for October, Vol. VI, published an article on the "Locomotive appendages of Trilobites." The specimen described is of great interest, and corroborates the evidence given by the Canadian Asaphus, described by Mr. E. Billings; unfortunately nothing is proven with relation to the oral appendages and branchiæ. The plates or figures, and a portion of the text were republished in the AMERICAN NATURALIST, for December.

J. S. Newberry, in the Proceedings of the U. S. National Museum, Vol. v, pp. 502–514, published "Brief descriptions of fossil plants, chiefly tertiary, from Western North America." No illustrations accompany these descriptions of fossil plants, mostly collected by Dr. F. V. Hayden, though many were collected by Professor T. Condon, by Professor J. J. Stevenson and I. C. Russell. Fuller descriptions with illustrations will appear in a volume which is to form one of the reports of the U. S. Geological Survey.

New York.—The second part of Vol. v of the Palæontology of New York, by James Hall, has appeared. It contains descriptions and illustrations of the Gastropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage, and Chemung groups, illustrated by a volume of 113 very good plates. Professor Hall has also published a few copies of the plates of part first, of Vol. v, of the Palæontology of New York: "Lamellibranchiata, plates and explanations." There are twenty pages of explanations, and eighty plates of very good drawings, especially those drawn by J. H. Emerton, of Lamellibranchiate shells from the Upper Helderberg, Hamilton, Chemung, and Waverly groups, Professor Hall still retaining the latter group in the Devonian. "The author has been allowed to purchase, from the Secretary of State, 100 copies of the plates already lithographed, for this volume, which are published in this form in order to make them available for the use of scientific institutions and students in palæontology. The text and additional plates of the volume, whenever published, will be sent to the parties receiving this portion of the work."

S. H. Scudder, in the Proceedings of the American Academy of Arts and Sciences, presented on October 10th, a paper on the "Fossil white ants of Colorado from Florisant;" six new species and one new genus are described; and Mr. Scudder argues that their presence at Florisant is indicative of a much warmer climate than the locality now enjoys.

R. E. C. Stearns, in the AMERICAN NATURALIST, Vol. XVII, No. 10, published an illustrated paper "On the shells of the Colorado desert and the region farther east."

E. O. Ulrich, in the Journal of the Cincinnati Soc. of Nat. Hist. for April, 1883, No. 1, p. 82, and for July, 1883, No. 2, p. 148, published his "American palæozoic Bryozoa." (Continued from Vol. v, 1882, p. 297.)

The twelfth annual report of the U. S. Geological and Geographical Survey of the Territories, by F. V. Hayden, contains "Contributions to invertebrate palæontology," Nos. 2–8, by Dr. C. A. White, an author's edition of which appeared in (July) 1883. It also contains a brief article on the "Palæontology of the Florissant basin," by S. H. Scudder, which is a reprint with additions and illustrations of the article published in the Bull. of the Survey, Vol. VI, Art. XI. It also includes a monograph of the North American Phyllopod Crustacea, in which the fossil Phyllopoda and Phyllocarida are enumerated.

Charles Wachsmuth and Frank Springer, in the *Amer. Journ. of Science*, for April, published "Remarks on *Glyptocrinus* and *Rhodocrinus*, two genera of Silurian crinoids." The same authors, in the November number of the same journal, published an article on "*Hybocrinus*, *Hoplocrinus*, and *Bærocrinus*."

M. E. Wadsworth, in Science, Vol. I, p. 422, published a note on "Molluscan rock-boring."

C. D. Walcott, in the advance sheets of the thirty-fifth report of the N. Y. State Museum of Natural History, published "Descriptions of new species of fossils from the Trenton group of New York," illustrated by one plate, No. XVII. In the *Amer. Journ. of Science*, he published a note on the "Injury sustained by the shell of a trilobite at the time of the molting of the shell." In *Science*, Vol. II, No. 46, p. 808, the same author published "Fresh-water shells from the palæozoic rocks of Nevada." This is a brief illustrated note of three new species, and one new genus of shells from the carboniferous strata of Nevada.

L. F. Ward, in Science, Vol. I, p. 358, published a brief article on "Plant life, past and present."

C. A. White, in the AMERICAN NATURALIST, Vol. XVII, No. 1, published his "Progress of invertebrate palæontology in the U. S. for the year 1882." In the *Amer. Journ. of Science*, for March, he published "Late observations concerning the molluscan fauna and the geographical extent of the Laramie group;" in the same journal for August, he published a note on the "Commingling of ancient faunal and modern floral types in the Laramie group." Dr. White has also published, in the annual report of the U. S. Geological Survey, 1881–1882, separately paged, with 32 plates, "A review of the non-marine fossil mollusca of North America." It is an important and lasting contribution to North American

æontology in a very useful form. In his preliminary remarks, Dr. White calls attention to his original view of the origin of non-marine mollusks, through the land-locking of marine types, and derives our present non-marine fauna of the Mississippi drainage system directly from the fauna of the old Laramie sea. In the Proceedings of the U. S. National Museum, Vol. v, pp. 94–99, Dr. White published, "New molluscan forms from the Laramie and Green River groups, with discussion of some associated forms heretofore known," illustrated by two plates, Nos. III and IV; these descriptions already appeared in his review of the non-marine fossil mollusca of North America. In the same publication, pp. 99–102, he has also "The molluscan fauna of the Truckee group, including a new form," illustrated by one plate, No. V; this also appeared in the review of non-marine mollusca.

J. F. Whiteaves, in the *Canadian Naturalist and Quarterly Journal of Science*, Vol. x, new series, No. 7, published a note on the "Occurrence of *Siphonotreta scotica* (Davidson), in the Utica formation, near Ottawa, Ontario." This paper was read before the American Association for the Advancement of Science, Montreal, 1882.

R. P. Whitfield, in the *Amer. Journ. of Science*, for May, published "Observations on the fossils of the metamorphic rocks of Bernardstown, Mass."

H. S. Williams read before the American Philosophical Society, April 20th, 1883, a paper on "A crinoid with movable spines." In the Proceedings of the Academy of Natural Science of Philadelphia, Part I, 1882, p. 17, Professor Williams published "New crinoids from the rocks of the Chemung period of New York State," illustrated by one plate, No. I. In the *Amer. Journ. of Science*, for February, Professor Williams published a paper on the "Fauna at the base of the Chemung group in New York," in which he gives a list of species found at High Point, Naples, N. Y., and comments on their similarity to the fauna of Lime creek, Iowa, referring it to the Kinderhook group, and argues that they are equivalent, and that as long as the Chemung is to be retained in the Devonian, the western beds should also be regarded as Devonian; he has apparently overlooked Professor S. Calvin's article in the *Amer. Journ. of Science*, 1878, Vol. XV, p. 450, in which the species mentioned are recorded as occurring also at the base of the Devonian in Iowa, showing them to have

a wide vertical range, and bearing out Dr. White's view, that the Devonian of Iowa belongs to a single epoch, probably the Hamilton. In the *Amer. Journ. of Science*, for April, p. 311, Professor Williams, in a note, acknowledged that he was wrong in speaking of the rocks of Lime creek, Iowa, as referred by Western geologists to the Kinderhook group, but maintained his view, that its fauna was represented in N. Y., at the base of the Chemung.

Wisconsin.—Vol. IV, Part III, of the Geological Survey of Wisconsin, contains descriptions of fossils, by R. P. Whitfield, illustrated by 27 plates of very good figures; some of the species are new, but most of them have already been described; the fossils described are not offered as a complete representation of the fauna of the several geological horizons of the State, but only as a few of the more prominent known species, together with some of the most characteristic new ones of the several localities from which they have been obtained; the volume also contains a general list of the fossils recognized within the State, including those described, and showing the formation in which they occur, which are the Potsdam, Lower Magnesian, Trenton, Galena, Hudson River, Niagara, Guelph, Lower Helderberg, and Hamilton. Professor Whitfield calls attention to the marked differentiation of the species of the Potsdam in different localities, according to the change in the lithological character of the matrix.

The first volume of the Wisconsin Geological Survey, which has been the last to appear, also contains a list of Wisconsin fossils, and in the general geology contained in the report, there are a large number of figures, many of which are reproductions of Professor Whitfield's plates; the other figures are compiled from various sources, and answer their purpose for a school text-book fairly well.

If those who notice them, will kindly call my attention to any omissions, I will insert them in next year's review, as it is intended to make this record as complete as possible.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— Professor Martin's address at the opening of the new biological institute at Baltimore, lately published in *Science*, calls attention emphatically to the lack of consideration and support

given to physiology in this country. This science is the basis of all sound medical practice, and the time cannot now be far distant when every reputable medical school will be forced to seek a professional physiologist to enroll among its professors. Few departments of science have changed more fundamentally within recent years than physiology. It is not long since it was barely more than a series of anatomical deductions enriched by a slight knowledge of the functions of organs, whereas it is now an exact and experimental science, which employs both the apparatus of the physicist and the reagents of the chemist as well as many instruments adapted to its own special needs, and which can be carried on only in the laboratory. Dr. H. P. Bowditch established at the Harvard Medical School the first well-equipped physiological laboratory in the country, and the example then set has since been followed elsewhere. It is to be hoped that the ample endowment of the Johns Hopkins University will be in part used to enable Professor Martin to develop his laboratory to the highest standard, and that it may exert a far-reaching influence towards promoting not only pure but also medical science, so that it may never fall behind its competitors, but become the worthy compeer of the Harvard laboratory. But while we welcome the auspicious opening of this department of the young university at Baltimore, we cannot escape a feeling of regret that the professor of biology, instead of aiming first at a secure position in medical physiology, even at the sacrifice of much else in biology, should not have fixed upon a higher ideal more worthy of a great university. Morphology, botany, general physiology and biology are all to wait, content to be the handmaidens of medical physiology. The magnificent opportunity to accomplish the immediate development of a school of scientific biology has been deliberately renounced. We deplore what we consider a serious mistake, and are unable to justify the postponement of proper university work in order to favor one class of professional men. Professor Martin's address must, we fear, disappoint many of the high hopes raised by the early aspirations of the Johns Hopkins University. It is too explicit a statement of a purpose too one-sided.

— For many years a number of the scientific members of the Philadelphia Academy of Natural Sciences have endeavored to preserve the institution for the use of a high standard of orig-

inal research. They long since foresaw what has many times been demonstrated, that its present organization means destruction to all important scientific work, and the substitution therefor of the mediocrity of the debating society. They have seen the inevitable amateurism of an unlimited membership gradually asserting itself in a neglect of the principal sources of scientific prosperity. With inconceivable apathy a few of the scientists of the academy have permitted this state of things to continue, when a little activity on their part would have turned the scales in favor of reform. Little help in this direction has been derived from outside the institution, for the public at large does not know the meaning of the words "original research," nor the importance of the ends attainable by it. Recently one or two of the younger specialists, imagining that their personal interest would be better served by joining the "popular" element, have abandoned the project of reform. This action on their part settles the near future of the institution. The only anxiety we feel is lest it receive gifts of money which may not be specifically applied to purposes of original research. If the use of such gifts be not so designated, they will not be directed to the uses for which the academy was created.

In view of this indefinite postponement of the development of this institution, various substitutes are now agitating the minds of some Philadelphians. One proposition is the creation of a school of biology, where research and teaching may be combined in a laboratory. Discussion of this plan has resulted in its adoption by some of the friends of the University of Pennsylvania, and there is considerable ground for hope that such a department of biological research, in connection with that institution, will receive an endowment. One objectionable feature in this scheme is the proposed directorship by one man. There should rather be several directors or professors, each in charge of a department. One man will necessarily be biased in the direction of his own specialty, and others will be more or less neglected. It is true that the chairs necessary for the conduct of a biological school exist in the academy, but so long as their occupants are excluded from the council of that body, competent men cannot be expected to hold them permanently.

Another organization is suggested, which shall represent in this State and city the academies of science of other countries. About twenty men are now living in this State who are distinguished for original researches in various fields of pure science. Such a body would supply a felt want, and its management would be free from the objectionable features which depress the prosperity of existing institutions. It would not probably be long without both museum and library. It is well known that the Academy of Natural Sciences is not likely to be the recipient of important collections under its present organization. It is also true that the

publications of the leading twenty scientific men of Pennsylvania would secure a magnificent return in exchanges for its library.

—— We inform interested persons, that the NATURALIST does not publish long obituaries; also, that no obituary notices of scientific men of a length of a page or less, has ever been declined by its editors.

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RECENT LITERATURE.

RYDER'S OBSERVATIONS ON EMBRYO FISHES.[1] — The Bulletin of the United States Fish Commission contains a series of articles upon various matters connected with the development of fishes, embodying the results of the investigations of Mr. J. A. Ryder during the year 1882.

The mode of absorption of the yolk of the embryo shad differs in the absence of a vitelline circulation from that which obtains in Tylosurus (Belone), Fundulus, Esox, and Salmo. The great mass of the yolk in the shad embryo consists of coarse, irregular masses of very clear protoplasmic matter, separated by a protoplasm which is optically different. The covering of the yolk is a palish amber-colored layer, quite different from the clear body of the yolk, and usually thicker at the end next the heart. The intestine lies in a longitudinal furrow on the dorsal aspect of the yolk-sac, and is never connected with it in this species. The yolk-sac is surrounded by a space filled with serous fluid. This space is capacious anteriorly, between the heart and the yolk, and this part is identified by Mr. Ryder with the segmentation cavity. The delicate pericardial membrane that separates this cavity from the pericardial space may, possibly, be perforate. In Tylosurus the two cavities are certainly connected. The heart opens freely into the segmentation cavity, and the appearance presented is that its persistent pulsation breaks up the yolk-substance into small spherules, sucks them out of the segmentation cavity, and carries them into the body of the embryo. The corpuscles develop on the surface of the outer yolk-layer, and after a while drop into the serous fluid, appearing like the white blood cells of human blood. As development proceeds, the yolk-sac becomes pointed in front, and the external layer becomes thicker, while the pericardial membrane becomes funnel-shaped to fit the anterior part of the yolk-mass. Before the final disappearance of the yolk, the liver of the young fish becomes more developed, and the portal vein makes its way over the dorsal aspect of the yolk towards the venous end of the heart. As the peculiar amber layer around the yolk persists to the last, it is probable that the central clear portion is transformed gradually into it.

[1] *Bulletin of the United States Fish Commission.*—Observations on the absorption of the yolk, the food, feeding, and development of embryo fishes, comprising some investigations conducted at the Central Hatchery, Armory Building, D.C., in 1882, pp. 179-205.

This is the history of the yolk-mass after the embryo is hatched, but as it grew in size before hatching, yolk absorption must have taken place before the heart was sufficiently developed to be an active agent in the process. This must be by *intussusception*, and in the amber yolk-covering it is undoubted that a process of cell and blood-cell differentiation takes place. Mr. Ryder concludes that the *hypoblast* of Gensch, said by that investigator to be the source from which the blood is derived, is the equivalent of the amber yolk-covering of the shad, and not the true hypoblast. This amber layer is a temporary structure, which disappears entirely, and does not enter into the formation of any organ or membrane. The serous cavity around the yolk in the shad represents the body cavity, and the outer covering of this, though only $\frac{1}{200}$ of an inch in thickness, contains epiblast, mesoblast, and hypoblast.

There is practically little difference between the modes of yolk absorption in the chick and in the fish.

A second note refers to some extraordinary hybrids derived from the impregnation of the eggs of the shad with the milt of the striped bass. Many hatched, several lived till they lost their egg-sacs, and about fifty were placed alive in a carp pond. The preponderance of characters was toward the female parent, but the teeth were more numerous and the gape of the mouth wider.

The fungus or alga, that is so fatal to shad eggs, develops wherever there is any imperfection in the circulation of the water. Three forms of glass hatching vessels, the Chase, the Clark, and the McDonald jars, are so arranged that every egg can be kept in continuous gentle movement, while they can be kept free from dead eggs without a skim net. Experiments with carbolic acid, in the hope of eradicating this fungus from the surface of the bodies of some large gold-fish that had become infested with it (probably derived from dead shad-eggs) failed completely. Mr. Livingston Stone states, that a strong solution of salt will kill it, while Mr. Behler recommends a saturated solution of salt water, and states that, if young salmon infested with the fungus are dipped bodily into asphalt, the fungus will be killed, and the young fish come out all right, the asphalt gradually peeling off.

A fifth note relates to feeding young shad with Daphnidæ, which, when transferred from the carp-ponds to the aquarium, were observed to die rapidly. The lower temperature may have been a cause, but the principal reason was doubtless the lack of the protozoa, algæ, etc., which form the proper food of the minute crustacea.

Another note refers to methods of handling the adhesive eggs of the white perch, and another to the proved destructiveness of sticklebacks to shad larvæ. Twenty-five of these were destroyed in half an hour by four *Apeltes quadricornis*. Both neuropterous

View on Great Salt Lake Desert, *showing mountains half buried by lake sediments*

and coleopterous larvæ are also capable of destroying young shad. Transparency is no safeguard against any of these enemies.

Well worthy of the attention of all naturalists are the original observations and categorical facts brought together by Mr. Ryder to prove that there is between ova, even of allied genera, considerable difference, and that at no stage is there a positive identity.

The mechanical construction, as it may be termed, of ova affects the course of their development. The Teleost ovum has a relatively enormous yolk, which must be included by the blastoderm in order to be absorbed, and this relatively large yolk has much to do with the difference observed between its development and that of a Marsipobranch or Amphibian. The eggs of the Salmonidæ have an abundance of oil drops in the vitellus, especially just under the germinal disk. These, by their buoyancy, keep the disk constantly directed upward. The cusk, the crab-eater, Spanish mackerel and moon-fish have eggs which are buoyant from the possession of a single large oil-sphere situated almost exactly opposite to the germinal disk, and thus keeping it face downward—just the reverse of what occurs in the salmonoids. Even after hatching, the young are at first unable to right themselves on account of the presence of the oil-drop. The cod ovum has no oil-drop, yet floats with the germinal disk downwards. That of *Morone americana* (white perch) is adhesive and fixed, with a very large oil-sphere which keeps the disk on the lower side of the vitelline globe. The shad egg is non-adhesive, and heavier than water, and the germinal disk has a constant tendency to arrange itself at the side of the vitellus as viewed from above, though there is no oil to influence it. In Fundulus and Syngnathus the oil-drops appear uniformly distributed. The number of proto-vertebræ or primary somites differs so much that while Tylosurus has as many as seventy-five pairs, Alosa has only eighteen to twenty. Our author ventures this bold remark: "When our knowledge is more complete, we shall perhaps be able to distinguish the species apart by the eggs alone, just as botanists have used the characters presented by seeds to distinguish plants."

Not the least of the differences, he truly observes, is form, but we can scarcely follow him to the conlusion that, since "the *somewhat similar* germs of different animals produce *different* species, we shall or ought to hold to the doctrine that the protoplasm of which a man is made is different from that of which the body of a dog or fish is composed."

Somewhat similar bricks may be formed into widely different buildings, but it does not follow that the clay differs. The same kind of clay may enter into the grandest erection and the meanest, while two very similar buildings may be made of different clay. Something the same, we conceive, occurs with protoplasm.

Its chemical constitution may differ, but the difference of animal species is mainly morphological, and there is no reason why different protoplasm may not occur in similar species, while species differing widely morphologically may be formed of similar protoplasm.—*W. N. L.*

WHITE'S GEOLOGY OF THE SUSQUEHANNA RIVER REGION.[1] While such a report as this is necessarily filled with details, Professor White has elicited some results (epitomized in the prefatory letter of Professor Lesley) especially bearing on palæontology and glacial geology, which are of general interest. Professor White finds fossiliferous beds high in the Catskill formation, some of the fossils of which appear to be of Chemung type. The discussion of this point is a most interesting one.

The geology of the great terminal moraine, the general course of which is outlined in the prefatory letter of the director of the survey, is discussed. As the ice-sheet, he says, covered the whole country, the high mountain plateaus and the low valleys alike, the moraine is in some places 2000 feet above ocean level, as in the North mountain; in others only 500 feet, as at Berwick. Professor White's observations on the floods of ice-water and the formation of the terrace-plain of part of Columbia county are of much interest.

The limits of the glacial drift in the counties surveyed are carefully given. "Glacial drift, as a sheet of unstratified sand, gravel and boulders, covers the whole region back of the moraine, and is finally exposed along water-courses. The thickness of this universal mantle of ice-borne trash, brought from the north, is about fifty feet; but where it is banked into the original hollows of the country, filling up ancient river valleys, it is much deeper. * * * Independent observers in other States have assumed fifty feet as about a fair general average thickness for the northern drift over the whole region back of the moraine. If this average be finally accepted, it must set at rest the vexed question of the eroding power of the ice-sheet; for fifty feet of eroded trash carried forward by the ice-sheet can only represent fifty feet (or somewhat less) of mother rock in place. This is an insignificant proportion of the amount of strata (from the coal measures down to the crystalline series) which has been removed from the crust of the earth in the long process of sculpturing the valleys and plains of Pennsylvania and New York, the Great Lake basins and the plain of Canada. Were the average thickness of the drift twice fifty feet, it would be equally true that the eroding power of the ice-sheet has been immensely overrated, and the

[1] *Second Geological Survey of Pennsylvania; Report of Progress G⁷. The Geology of the Susquehanna River region in the six counties of Wyoming, Lackawanna, Luzerne, Columbia, Montour and Northumberland.* By I. C. WHITE. With a geological map in two sheets, and thirty-one page plates in the text. Harrisburg, 1883. 8vo, pp. 464.

what erosive power it had was exhausted in merely polishing off and puttying up the topography of the continent." In this paragraph we have a reiteration of Professor Lesley's well-known views, which, though somewhat extreme, are based, doubtless, on the condition of things in Pennsylvania at the former thin edge of the continental glacier. Where, as in the Great Lake region, the ice was undoubtedly thicker and remained a much longer time, the erosion probably went much deeper. We still greatly need a systematic review of all the facts bearing on the thickness of the morainal matter in different localities over the entire glaciated area of North America. In the Rocky Mountain area most certainly, the amount of erosion and of morainal matter are comparatively slight. The observations which are being made by the Pennsylvania survey are, it seems to us, perhaps more detailed and complete than those of other regions. In the New England States, where the ice lasted longer in the White Mountain region than elsewhere, and where the moraines and ice marks are the most recent, we need far more detailed and connected observations than have yet been made.

To return to our report. From the field work of Professor White, it results that, "Outside, or to the south and west of the moraine, the tops and slopes of the mountains and higher hills of Columbia, Montour and Northumberland counties show no signs of the former presence of ice—no unstratified drift, no ice scratches, no *kames* (formed in ice caverns by subglacial torrents). But the whole country *below* the level of 800′, or 750′ above tide, is more or less covered with a post-glacial stratified deposit of *modified drift*, derived from the moraine and from the glacial drift which covers the country behind it to the east and north." Here the thought arises, if the immense mass of modified drift has been, as it probably has, "derived from the moraine" to the northward, does not Professor Lesley underestimate the original amount of material removed from the rock surface by the glaciers? Was not the depth of erosion originally more than fifty feet?

Then, in rather more florid language than we are accustomed to meet with in State geological reports, the director goes on to say: "These *post-glacial terrace deposits* are supposed, by Professor White, to mark a flooded river age, beginning with that general rise of the thermometer all over the world, which rapidly melted back the ice-sheet and left the continent in its present genial condition. The winter of the ice age was over; the summer burst upon the world; the mountains appeared again; the valleys were reëxcavated. Unimaginable floods poured southward without cessation along all the valleys, and spread out over the lowlands their burdens of moraine stones, rounded and smoothed by the tumultuous waters. When quieter times came, the Susquehanna river and its affluent streams cut down through these post-glacial deposits, as shown by the terraces which now border their

banks." Here again the inquiry arises, How could these tumultuous, "unimaginable floods" have poured southward "without cessation" if the ice-sheet was so thin and meager as Mr. Lesley imagines? The hyper-cataclysmal language here used for the series of phenomena, the result of a melting of an ice-sheet which was merely thick enough to "polish off" the topography of a continent, appears somewhat illogical and extreme. Should it not apply to the ice-mass as well? Farther on, to account for "vast heaps of rounded boulders" and other drift deposits on the tops of crests, ridges and hills at elevations of near 1000 feet in the counties above named, the director of the survey remarks: "It seems to me necessary to suppose some sort of submergence of the region beneath sea-level, or, what will amount to the same thing, a general rise of ocean-level to 800′ or 1000′, A. T. This would flood all Southeastern Pennsylvania to within a few hundred feet of the crests of its mountains, and account for most of the terrace deposits in this region."

While Northeastern New England has evidently been submerged some 500 feet, as marine fossils clearly indicate, are there any facts which show that this submergence extended much, if any, below New York city? We have supposed that south of this point the oscillation of the coast line was confined to but a few feet, as witnessed by the position near sea-level of the Quaternary beds of South Carolina.

The continued survey of the surface geology of a region like Pennsylvania, which lies both south and north of the great terminal moraine, will, in the end, aid much in solving such questions as have been brought up in the present able report.

SECOND REPORT OF THE U. S. GEOLOGICAL SURVEY.[1]—Though this report has been issued for some time it has not been noticed in this magazine. It is a bulky royal octavo volume, well printed on good paper, with excellent and abundant illustrations (sixty-one plates and thirty-two wood-cuts); the mechanical execution being much superior to the average Government report. The more notable contents are the reports on the physical geology of the Grand Cañon district by Capt. C. E. Dutton; Contributions to the history of Lake Bonneville, by G. K. Gilbert; abstract of a report on the geology and mining industry of Leadville, by S. F. Emmons; a summary of the geology of the Comstock Lode and the Washoe district, by Geo. F. Becker; production of the precious metals in the United States, by Clarence King; a new method of measuring heights by means of the barometer, by G. K. Gilbert.

The splendid report of Captain Dutton on the Grand Cañon district having been published in full, we shall defer our notice

[1] *Second Annual Report of the United States Geological Survey to the Secretary of the Interior, 1880–'81.* By J. W. POWELL, director. Washington, 1882. 8vo, pp. 588.

PLATE XV.

Tabernacle Crater and lava beds.

it to another occasion, and meanwhile draw attention to Mr. Gilbert's elaborate essay on Lake Bonneville, a subject which he has studied for a number of years past.

The sediments of this ancient Quaternary lake rest upon Pliocene rocks, which are hard enough to be used as building stone, and in many places have been upturned, faulted, while portions, separated from their continuations in the valley, have been carried high up on mountain flanks, where they have been eroded into typical mountain forms.

From his study of the lake sediments and ancient beaches, Mr. Gilbert suggests the following history of the lake:

1. A long period of dry climate and low water, during which the mountains of the desert were buried and the alluvial slopes of marginal mountains were formed (Pl. XIII).

2. A period of moist climate and high water, during which the yellow clay was deposited and the shore was carried within ninety feet of the summit of the lowest barriers of the basin.

3. A period of extreme dryness, during which the lake disappeared and its salt was buried.

4. A relatively short moist period, during which the white marl was thrown down, and within which the water overran the barrier, diminishing by erosion its height at the point of discharge.

5. The present period of relative dryness.

The volcanic rocks of the lake valley are basalts; of these Pavant Butte (Pl. XIV), situated between Fillmore and Deseret, is the most conspicuous. It is entirely composed of tuff. Midway between its base and its summit it is encircled by a terrace formed at the highest stage of the lake. The mountain was a sublacustrine volcano; its cone having been completed during the highest stage of the lake.

On the other hand another volcano, the Tabernacle (Pl. XV), has no "benches" or shore lines, and no lake beds resting upon it. The volcano began to be formed there during a high stage of the lake, and was continued or renewed after the water had fallen below the level of the vent; while facts show that the date of the last eruption from the vent was just before the final subsidence of the water. The period of volcanic activity has lasted, then, through the entire history of the lake, and perhaps the end has not yet been reached. "No one," says Mr. Gilbert, "who has seen the fresh, black, unworn surfaces of the most recent *coulees*, still absolutely barren of vegetation, could be affected by surprise if it should some day be announced that the now quiescent fires had again broken forth."

It appears that there is a difference in the height of the Bonneville and Provo shore lines, neither of the two shore lines being now horizontal or parallel; hence it is inferred that there have been orographic movements both during the existence of the last

high stage of the water and since the final subsidence; and it seems that the region of the eastern margin of Lake Bonneville has recently fallen and is still subsiding. Mr. Gilbert has also found that a recent fault has taken place along the Wasatch range, not yet completed in the rear of Salt Lake city, and that the Wasatch range, the greatest mountain mass of Utah, has recently increased in height, and is supposed to be still growing.

The remains of Lake Bonneville is now but a great shallow brine pool, and resting on the surface of a broad plain. "Its mean depth is scarcely fifteen feet, and only a slight oscillatory movement of the plain would be necessary to decant its waters into another portion." It thus appears that the Mormons are exposed to the liability not only of losing their lake, but also their chief city!

HOPLEY'S SNAKES, CURIOSITIES AND WONDERS OF SERPENT LIFE.[1]—This pleasantly written book ought certainly to cure some of its many readers of their inherited hatred of snakes. The introduction brings out amusingly the confusion of names and natures which prevails among humanity, and the publisher's dread that he should lose subscribers if he put snakes in his magazine is but a mild manifestation of the ordinary horror of these creatures.

Thoroughly aware that the majority of even those people who have read of the peculiar structure of the skeleton, and especially of the jaws of a snake, do not realize the manner in which these peculiarities, correlated as they are with important departures from the ordinary reptilian type in the soft parts of the body, modify the habits and actions of snakes, Miss Hopley is careful to describe from the life how snakes feed; what the tongue is and is for; how snakes breathe and hiss; how they climb and constrict their prey; and how their teeth and fangs are constructed and arranged.

The author avers that a few years ago she knew nothing about snakes, and it is this fact, joined with sound judgment and correct observation, that has enabled her to write a book that speaks to those who do not know. When she discusses such questions as "Do snakes drink?" "Do they incubate their eggs?" and "Do they afford a refuge to their young?" she not only critically examines the opinions of others, but adds observations of her own that seem convincing. For example, the yellow Jamaica boa's method of imbibition, is thus described: "The snake kept its mouth just below the level of the water, and the only action or movement seen was at the back of the head, or on each side of the neck, like a pulsation, as the water passed down in short gulps. This is the 'suction' which writers describe, a drawing in of the liquid; but the lips do not take part in the act. When

[1] *Snakes, Curiosities and Wonders of Serpent Life.*—By Catherine C. Hopley. Griffith & Farran, St. Paul's Churchyard, London, and E. P. Dutton & Co., New York, 1882.

therefore, we read that snakes drink both by lapping and by suction, we may surmise that the former is for the benefit of the tongue." The incubation of *Python sebæ* is described, and the viviparity or oviparity of snakes generally, is clearly shown to depend simply upon the longer or shorter retention of the eggs within the body of the mother, and to vary in the same species. That some species afford a refuge for their young, is regarded as proved, and the author believes that this occurs in viviparous snakes, or in those in "which from some cause or other extrusion has been so postponed that the young are conscious of existence before birth." The habit is referred to a knowledge on the part of the young of the locality which formerly afforded protection, and remembrance on the part of the mother of previous protection afforded. The protrusion of the glottis during the act of swallowing, so as to enable the snake to breathe while the entire space between its jaws is occupied by living prey, is another little-known point in the economy of snake-life that is rendered clear in these charming pages.

Fascination is explained as of varied origin, in some cases curiosity, in others fear, in still others maternal anxiety for the fate of the young. The swiftly darting tongue is spoken of as a successful lure for birds, which appear to mistake it for a worm or insect. Cures for snake bites are discussed, and it is shown that though many powerful stimulants are successful as remedies, no real antidote for snake-poison is yet known. The illustrations, though few, are well chosen, and most of them original, showing attitudes assumed by snakes under various conditions.

The general reader will find the book a fascinating one, while the more scientific student will rise from its perusal with the consciousness that, though he might have previously known a great deal about snake anatomy, he has learned something new about snakes themselves.

BULLETIN OF THE BUFFALO SOCIETY OF NATURAL SCIENCES.—The final number of the fourth volume of the organ of this active society has just been received. It is a brochure of nearly 140 pages, and is devoted to an enumeration of the cryptogamic plants of Buffalo and its vicinity, in continuation of the catalogue of phænogamous plants, by David F. Day, forming Part III of the same volume. The first two numbers contain entomological, palæontological and ornithological papers of value.

THE STANDARD NATURAL HISTORY.—Nos. 7 to 10 of this valuable publication have reached us. In No. 8 the account of the stalk-eyed Crustacea, prepared by Mr. J. S. Kingsley, is finished; then succeeds the sessile-eyed Crustacea; the groups of Arthropoda of doubtful position, including the Pycnogonida, the Trilobites and Merostomata, as well as the Pentastomida, all prepared by Mr. Kingsley, who then offers an introduction to Class II. Insecta, the part closing with the commencement of an account

of the first sub-class, Malacopoda (Peripatus). This, like the other parts, is illustrated with well-printed wood-cuts.

In Part 7 Dr. Coues completes the Rodentia. This order is succeeded by Dr. Gill's account of the Insectivora and Chiroptera. The work is both modern and popular in its treatment, and can not fail to adequately fill a hitherto empty niche in the naturalist's library.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*The Ancient Gulf of Triton.*—Dr. Rouire (*Rev. de Geog.*, Janv., 1884) believes that he has satisfactorily identified the Gulf of Triton mentioned by Herodotus and other writers with Lake Kelbiah, and the country between it and the sea. The Chotts of the Tunisian Sahara can scarcely have been this gulf since the bar of Gabes, which divides them from the sea, is not alluvial, but is composed of older geological beds, rising more than 130 feet above sea-level. Moreover, remains of prehistoric dwellings have been found upon this bar. To the north of Gabes, between Enchir Béniana and Erghela, is a veritable sand bar some four miles long, separating the "Sebka" Djériba from the sea. Further back rises the elevation of Djémiah, and on each side of this passes a branch of the dry Oued Menfes, leading into Lake Kelbiah, a sheet of water about thirteen miles long. Beyond this lake is the valley of Kroussiah, bounded by an abrupt cliff some 200 feet high, presenting indubitable signs of having been an ancient coast line. In rainy seasons the waters of the Oued Bagla pour into Lake Kelbiah, which rises until the valley of Kroussiah is inundated, and the waters fill the dry channels of the Oued Menfes, and communicate with the sea

[1]This department is edited by W. N. LOCKINGTON, Philadelphia.

For awhile the Gulf of Triton is formed as described by Herodotus. At the mouth of the gulf is the Island of Phla, equivalent to the temporary Island of Djémiah, between the branches of the Oued Menfes, and further inland the waters of the lake bathe the shores which, before the narrow sand bar was thrown up, were permanently washed by the sea. The Little Syrtes of Scylax is thus identified with the Gulf of Hammamet, Hadrumetum with Sousa, Leptis Parva with Lemta, and Neapolis with Nabel-Kedimi. Communication between the Sahel and the interior of Tunis is even now difficult and dangerous during much of the year, for, except to the south, towards Sfax and Gabes, the bed of the ancient sea, still marshy and apt to be flooded, must be crossed. These identifications necessitate a new interpretation of many historical passages referring to the history of Carthage.

The Wolofs and the Kingdom of Cayor.—The Wolofs were formerly united into one kingdom, but now form three. Of these Cayor extends southward from St. Louis to a little beyond Cape Verd. It has no river, but a chain of fresh-water lakes or marshes a few kilometers from the ocean gives rise to a luxuriant vegetation ; and the rest of the country, watered by abundant rains from July to October, yields an abundance of fruit and vegetables, though water can only be obtained from wells. Contact with the French and the Moors has made Christians of some Wolofs and Islamites of others, but Gen. Faidherbe (Bull. de la Soc. de Geog., 1883) confesses that the former are more drunken, and the latter more false, than their heathen brethren.

Asia.—*Kafiristan.*—Mr. McNair, who penetrated Kafiristan in disguise, to escape the opposition of the surrounding Mohammedans, has recently given to the Royal Geographical Society an account of his visit.

Kafiristan contains 5000 square miles, is bounded on the north by the Hindu Kush, on the south by the Kunar, and on the west by the Alishang and its tributary, the Alingar. On the east its boundary is not clearly defined, but may be roughly said to run from the Dara pass to the source of the Kalashgum, down that river to its junction with the Kunar, and down the latter to its union with the Kabul. There is also an isolated tract north-west of the Dara pass. The three main tribes are the Ramgals, Vaigals and Bashgals, each occupying one of the large valleys. Each tribe has a district of its own, and, as a rule, has little to do with the other valleys. The Vaigals are reckoned to be most powerful. Three of the five tribes of the Bashgal pay a nominal tribute to the Mohammedan rûler of Chitral, but the other two are quite independent. The entire population is estimated at 200,000 souls. The men have sharp Aryan features and keen, penetrating eyes, usually brown, but occasionally blue. Brown eyes and light, even golden hair often occur in combination. The complexion

varies from extreme fairness, almost pink, to a bronze, as dark as that of a Pathan. The cast of features seems the same in both, but the fairer men will say that they came from the north, and their darker brothers from the south. They are short of stature, daring, but lazy, leaving the agricultural work to the women, and spending their own time in hunting. They are passionately fond of dancing, in which both sexes join in the evening round a blazing fire. The houses are generally built on the slopes of the hills; the lower story is of stone, from twelve to fifteen feet high, and is used for storage of wood and of the ordure of cattle, which is used for fuel. The upper story, or house proper, is built of wood, and contains only one or two rooms, which are neat, but very dark. The door and door-frames are roughly carved with figures and scrolls, and there is but little furniture. They all sit on wooden chairs or wicker stools. Their bread is ordinarily a very thick cake, but thin, broad cakes are made when guests are entertained. Meal, boiled in a large iron caldron, is served in deep, circular wooden vessels, hollowed from a tree. Tables seem to be used only to place drinking-vessels upon. The cheese is of the nature of cream-cheese, is made daily, and is given to guests between two cakes, embedded in hot butter. Their beds are rude fixtures of poles, one end of which rests in the walls, the other on two legs. This story is reached by a ladder, which can be drawn up. Sometimes there is a third story, also of timber. A platform surrounds the upper stories. The roof is of flat stones laid on beams and covered with mud.

The temples are square chambers of timber, with carved and colored doorways; inside are several stones, apparently boulders from the river bed, but no images were seen, except those connected with funeral rites. The temples seem to be chiefly used in connection with these rites. The coffins are carried there and sacrifice performed before burial. The men shave the whole of the head, save a patch on the crown; and usually wear Indian cotton clothes; the women wear a single garment, something like a loose morning gown, and the hair is worn plaited and covered over with a broad cap with lappets. Just over the crown stick up two tufts, which look like horns. Slavery exists to a certain extent. Polygamy is the exception; a mild corporal punishment is inflicted on unfaithful wives, and a fine of cattle-heads is exacted from the male offender. The dead are not buried, but placed in coffins in a sort of cemetery, often on a hill-side. Carved wooden figures are placed at the heads of the coffins of persons of rank and note of either sex. One Supreme Being (Imbra) is universally acknowledged. They drink much wine, pure, unfermented grape-juice. Their arms are bows, arrows, and daggers. A few matchlocks have found their way into the country, but they make none.

The country is picturesque, densely wooded, and wild in the

extreme. Mr. McNair is the first Englishman who has penetrated into Kafiristan, and even he, owing to the penetration of his disguise through the treachery of a supposed friend of the British government, did not go beyond the outskirts.

The Swat valley, reached by the Malakand pass (3575 feet), has a very rich soil, but is unhealthy. In it are many Buddhist topes, some quite as large as the famous tope of Muni Kiyala. There are also many excavated caves. Colonel Yule (in the discussion which followed Mr. McNair's narrative) stated that this valley, the natives of which had become Afghanized, was eighteen to twenty centuries ago one of the most sacred spots of Buddhism. At Dir Mr. McNair received a seal, which proved to be of Babylonian workmanship.

The Kafirs are ever at war with their Mohammedan neighbors, and are said to pray: "Ward off fever from us. Increase our stores. Kill the Mussulmans. After death admit us to Paradise." Yet many have been, during the course of ages, converted to Islamism. Sir H. Rawlinson said that there was no foundation for the belief that these Kafirs or infidels, as the Pathans called them, were descended from Alexander's soldiers. Their languages are of the Perso-Indian branch of the Aryan family.

The pass leading from Swat valley is 7310 feet above the sea; the fort of Dir 5650 feet; the Lowara Kotal pass, leading to the valley of the Kunar, 10,450 feet; and Chitral, at the head of the Shushai valley, 5151 feet. The dorsal ridge of the Hindu Kush has here a mean elevation of about 16,000 feet, while the Tirach Tir mountain is 25,426 feet high.

GEOLOGY AND PALÆONTOLOGY.

T. S. Hunt on Cambrian rocks of North America.[1]—The writer gave his reasons for limiting the term Cambrian to the Lower and Middle Cambrian of Sedgwick, which contain the first fauna of Barrande. For the Upper Cambrian or Bala group holding the second fauna, wrongly claimed by some as a lower member of the Silurian, and by others called Cambro-Silurian, he prefers the term Ordovician, now accepted by many British and continental geologists. This includes in New York the Chazy, Trenton, Utica and Loraine divisions, the Oneida marking the true Silurian or third fauna. The Cambrian rocks of the great North American basin may be studied in four typical areas: 1. The Appalachian; 2. The Adirondack; 3. The Mississippi; 4. The Cordillera area. To the first of these belongs the immense volume of greatly disturbed sediments along the whole eastern border of the basin, constituting the First graywacke and the Sparry limerock of Eaton, being the Upper Taconic of Emmons, and the Potsdam group and Quebec group of Logan.

[1] Abstract. Read before Boston Soc. Nat. History, Feb. 20, 1884.

They are distinct from the unconformably underlying Taconian quartzites, marbles and schists (Lower Taconic) which the author regards as Precambrian, and the still older crystalline schists of the Atlantic belt, including those, chiefly of Huronian age, which have been called "Altered Quebec group." The name of Taconic cannot be retained for the Appalachian Cambrian, which was, as early as 1861, correctly claimed by Emmons as belonging to the period of the first fauna. The Hudson River group, as originally defined, included the whole of the Appalachian Cambrian, with some portions of the underlying Taconian, and others of overlying Ordvician strata, from which in the Appalachian area their characteristic limestones are wholly or in great part absent. It is from solely this association with the Cambrian graywacke of strata of Loraine age that the Hudson River group has come to be regarded as the palæontological equivalent of the Loraine.

In the stable and little disturbed area around the Adirondack mountains, including the Champlain and Ottawa basins, the Cambrian is represented only by the quartzites and magnesian limestones of the Potsdam and Calciferous divisions, which are shallow-water deposits, corresponding apparently to small portions only of Cambrian time. The physical conditions of the Mississippi area appear to have been similar to that of the Adirondack region. As seen to the west of Lake Superior the lowest Potsdam beds of Hall rest unconformably upon the great Keweenian or copper-bearing series. This, although containing, as the speaker had elsewhere shown, some evidence of organic life, probably worm-burrows and sponges, cannot be claimed for the Cambrian till it shall have been shown to contain a Cambrian fauna. In this north-western area we find, moreover, beneath the Cambrian horizon, representatives of the Laurentian and of the Norian. The latter in the typical norites or so-called gabbros, which, near Duluth, are directly overlaid by the Keweenian, elsewhere resting on Laurentian or on Huronian rocks. There also are found in Wisconsin petrosilex rocks of Arvonian type, with quartzites, rising from beneath the Cambrian sandstones. Typical Montalban and Huronian rocks also occur around this area, besides the group which the speaker long since called Animikie. This great series, of many thousand feet, which is overlaid unconformably by the Cambrian sandstones, and also, according to Irving, by the Keweenian, consists chiefly of quartzites and argillites with beds of magnetite. The remains of a sponge have been detected in a calcareous mass got by the speaker at Thompson, Minn., from the argillites of this series, which, in a late communication to the National Academy of Science, he has referred to the Lower Taconic or Taconian horizon. He now stated his conclusion, drawn from various facts, that while these Animikie rocks rest unconformably in this region upon the Huronian, the two series have hitherto been confounded under the common name of Huronian.

As regards the Cambrian of the fourth area, that of the Cordilleras, the speaker alluded to the important observations of Powell and the recent studies of Walcott. Great local variations may here be looked for, and discoveries which will enable us to understand better the relations between the Appalachian Cambrian and the other areas mentioned, as well as those on the Atlantic coast in Massachusetts, New Brunswick and Newfoundland.

THE GEOLOGY OF ALGIERS—FORMATIONS BELOW THE TERTIARY.—In a recent issue of the *Annales des Sciences Geologiques*, M. A. Peron describes, with great thoroughness, the geology of Algiers. The great geographical feature consists of two parallel chains of mountains, bearing from W. 17° N. to E. 17° S. These mountains were uplifted in the Quaternary age, so that, as in the Alps, the Tertiary strata have been disturbed, and contribute to the formation of the mountains. Between these two parallel ranges lie an elevated zone of plateaus, which was uplifted at the same time. To the south of the southern crest extends an immense region through which the strata lie horizontally. This is the Algerian Sahara. Beyond this, on the confines of the Soudan, traces of dislocation appear, with eruptive rocks, and some vegetation. The different geological strata are disposed in long belts parallel to the coast, and the same arrangement obtains in Tunis and Morocco. The country is thus divided into zones, bearing each its distinct soil and climate, productions and people. The principal axis of the Algerian chain is that of the north, and it is this which has determined the direction of the Mediterranean coast. Previous to the uplift of the mountains, repeated and considerable outflows of igneous rocks had taken place, but the greatest outflow occurred in the Quaternary epoch. A great part of the effects of this plutonic outburst are hidden beneath the sea, but the northern coast of Sicily to the east, and Madeira to the west, are in the line of the basalts of the African coast. The rivers which flow northward and southward all have their origin in the plateau region between the two chains of mountains, and no visible crest separates streams running in opposite directions. Every one of these streams has to pass across the mountains, and hence results the multitude of gorges by which these chains are intersected. The oldest strata are crystalline schists, granite gneiss, mica schist, etc. These occur upon the coast, and form mountain masses or islands. Palæozoic strata are not extensive, but are most developed in the province of Oran. Some schists, with vegetable impressions, graphitic schists, etc., are referred to the Silurian, and the puddingstones and conglomerates with polyps, encrinites and foraminifera of the environs of Ain-Talba, are referred to the Carboniferous by M. Bleicher. The Devonian does not seem to be represented in Algiers, though it undoubtedly occurs in Fezzan. No traces of the Permian have yet been found, and the identification of certain

beds with the Triassic rests solely upon their position below the Jurassic, and has no palæontological proof. Most of the horizons of the Jurassic are represented, but organic remains are rare, and the strata are sometimes metamorphic. The oldest Jurassic strata exist in the mountain region, and are marked by characteristic species. The Upper Jurassic (*corallien*) appears to form a long band running from east north-east to south-south-west across the high plateaus. The Neocomian, or Lower Cretaceous, is met with in the Tell, or mountain region, in the high plateaus, and as far as the confines of the Sahara, yet does not occupy large areas. The Urgo-Aptien (as our authority styles the strata between the Neocomian and the Gault), occupies large areas in the south of the country. The Gault (*Albien*) acquires in Algiers a thickness of 150 to 300 meters, and is in great part composed of rocks deposited mechanically. It presents distinct characters in different parts, and is tolerably rich in fossils. The Cenomanian is one of the most important and widely spread formations of Algiers. reaches a thickness of 500 meters, and enters into the formation of almost all the mountain masses, except those of the coast. Wherever this formation extends the surface of the country is particularly uneven, full of ravines and peaks, or rocky crests of difficult ascent, and almost completely sterile. These strata are as poor mineralogically as agriculturally, but fortunately they are extremely rich in fossils. Though the Cenomanian occurs in the north, its greatest development is in the parallel chains which separate the long depression of the chotts from the Sahara.

The Turonian is also extensive. It is composed of a considerable mass of limestone with *Rudistes*, and of some other beds between this and the Cenomanian. It occurs in the Tell, or northern mountain region, in the high plateaus, and in the Sahara. The Senonian, or Upper Chalk, is utterly unlike the parallel stage in France. It is composed of marls and limestones, usually almost black, and the fossils consist to a large extent of gastropods and lamellibranchs, especially oysters, and echini. In the 400 meters of this stage neither sandstone, sand, dolomite, flint, nor chalk are met with. The whole appears to have been deposited in a deep and quiet muddy sea, under similar conditions, for the facies of the fossils is pretty much the same throughout the various beds, and though individuals are plentiful, specific types are few. Polyps, sponges, polyzoa and brachiopods are entirely absent. Rudistes are very rare, and cephalopoda represented by but few species principally of Ceratites.

THE SKULL OF A STILL LIVING SHARK OF THE COAL MEASURES.—The genus Didymodus is a well-known form of Elasmobranchi of the Coal Measures, and I have reported it as occurring also in the Permian. Mr. S. Garman has recently published an account of a shark supposed to have been taken off the coast

of Japan, which he names *Chlamydoselachus anguineus*,[1] referring it to a new genus and family. He figures the teeth, and these are, as I have pointed out,[2] identical with those of the genus above-named.[3] The species should then be called *Didymodus anguineus*.

Crania of species of Didymodus are not uncommon in the Permian formation, and a description of the character of this part of the skeleton forms the subject of a paper recently read by the writer before the American Philosophical Society of Philadelphia.

The palatopterygoid arch is suspended to the postorbital process of the cranium as in the existing Hexanchidæ. The genus would then be referred to the sub-order Opistharthri of Gill, but for the following peculiarities: The skull is segmented, so that cartilage-frontals, parietals and occipitals can be distinguished, together with an element which has the position of the intercalare. The occipital supports a large vertebral cotylus. There are membrane bones extending from the nose over the orbits, which are either supraorbitals or frontals. The tissue of the bones is granular, which leads to the belief that the granular ossification which covers the chondrocranium in recent sharks, penetrated the entire chondrocranium in this genus. Hence the basicranial axis consists of the sphenoid and presphenoid bones. One at least of the nares is on the superior face of the muzzle. The frontal cartilage-bones are elevated and fissured at the posterior extremity, each apex projecting freely upwards and backwards, presenting a certain resemblance to the structure seen in the Lepidosirenidæ.

The structure points to the type from which the true fishes (Hyopomata) diverged from the sharks. The characters are thought to define an order of the sub-class Elasmobranchi, equivalent to all the other known forms. To these two divisions were given the names of Ichthyotomi and Selachii.—*E. D. Cope.*

Lesquereux on Cretaceous and Tertiary Plants.—The eighth volume of the final reports of the U. S. Geological and Geographical Survey of the Territories on the Cretaceous and Tertiary flora of the Western Territories, by Leo Lesquereux, has been in type at the Public Printing-office in Washington for over six months past, and will be issued soon. That it will prove to be a very important contribution to the vegetable palæontology of the United States the following brief synopsis will show:

Besides the description of species, the text gives general remarks on the geology of the Dakota group, on the characters of the plants in regard to climate, and their affinities with forms of succeeding geological periods. A table of distribution, enumerat-

[1] Bulletin of the Essex Institute, VOL. XVI.
[2] *Science*, March 7, 1884, p. 274.
[3] Didymodus Cope. Proceedings Academy Philadelphia, 1883, p. 108. Diplodus Agass., name preoccupied in recent fishes.

ing all the species known until the present time, of the flora of the Cenomanian in Europe, North America and Greenland, points out the relation with the plants of different localities. Atawe for Greenland; Moletin Inedlinberg, Needersham, the Quader sandstone, &c., for Germany; and the Dakota group, with species obtained in Nebraska and Kansas, and those found also in Colorado at the base of the Rocky mountains. The above refers to the first part of the report, the Cretaceous flora, with seventeen plates.

The second part comprises a revision of the plants of the Laramie group: 1st. Introduction, considering the relations of these plants with those of Europe, to establish the age of the formation. 2d. Descriptions of a few new and well-marked species from very fine specimens, with three plates. 3d. A table of distribution, including only the species of the Laramie group, which in the seventh volume were mingled with those of the other stages of the Tertiary, and were not grouped distinctly enough for the appreciation of the general characters of the flora.

The third part comprises the flora of the Green River group. The characters of the plants separate the formation into the divisions. The plants of the Green River and Alkali stations, and Randolph county, being different, most of them, from those of Florissant, mouth of White river and Elko. The description of the species are illustrated by twenty-one plates, and the relation of the flora with that of the Gypses of Aix, in France, which is considered as lowest Miocene or Oligocene, is indicated. The table of distribution of these plants includes for America those of Florissant, Elko, Green River station, Alkali station, Sage creek, Barrell's springs, in relation with the Miocene of Greenland, Alaska, the Oligocene of France and Germany, and the Miocene of Europe. The table is followed by general remarks and conclusions derived from the comparisons.

The fourth part relates to Miocene plants described from specimens received from the Bad Lands, California, Oregon, and Alaska; three (3) different groups considered separately. The illustrations fill fifteen plates, and one plate for a few species from a more recent Tertiary formation of California, probably Pliocene. The table of distribution indicates the relation of the species of Alaska, Carbon, Washakie, the Bad Lands, Oregon, California, Fort Union group, with the Arctic Miocene, Greenland, Spitzbergen and that of Europe.

This eighth volume is a complement of the two preceding, the sixth and seventh. It describes, figures or enumerates all the plants which have been found up to the present time in the formations of Mesozoic and Cenozoic epochs of North America, and, therefore, contains most valuable materials in vegetable palæontology for the direction of future researches, and the classification and determination of the fossil flora of the continent.—*F. V. Hayden.*

GEOLOGICAL NOTES.—*General.*—The *Revue Scientifique* (Jan. 19) contains a geological map and description of Borneo, according to the recent explorations of Dr. T. P. Tivadartol. Situated in the midst of a volcanic region, this great island contains no active volcano. The five central mountain chains, which radiate from a common center and attain some 4000 meters in height, consist of amphibole-gneiss, mica-schist, and talc-schist, with intercalations of peridote and serpentine, very strongly folded. The cincture of undulating hills around these mountains is arenaceous, and is believed to be eocene, and the vast plains between these hills and the sea consist of ancient and modern alluvium. Some arenaceous clays, impregnated with salt, serving as a substratum to the vast salt-marshes of the lower parts of the island, seem older than the eocene hills, and may be of secondary age.——The Alps of New Zealand, according to Mr. Green, were probably uplifted in Jurassic times. The oldest rocks — granites (or possibly in part granitoid gneisses) appear on the western side; these are overlain by crystalline schists, to which succeed slates, grits, etc., of Silurian and later ages. The highest rock on Mount Cook (12,349 feet) appears to be a quartzite, and Mr. Green mentions the occurrence of some volcanic tuffs lower down the mountain. ——Mr. E. T. Hardman has obtained the data for a geological sketch-map of 12,800 square miles in the Kimberley district of Western Australia. The lowest rocks are quartzites, schists and other metamorphic rocks, which he provisionally classes as Lower Silurian, but which may be Archæan. These are succeeded by limestones and sandstones with gypsum, etc., supposed to be Upper Carboniferous. The newest deposits are Pliocene sands, gravels, conglomerates, and marley limestones (called "pindar" by the natives), overlaid by river gravels, extensive plains of alluvium, and, along the sea-coast, by raised beaches. Certain basalts and felstones of uncertain age also occur.——The report of the Geological Survey of Prussia, for 1882, contains twenty-two important papers, by members of the staff and others, with twenty-three plates of maps, sections and fossils.

Cretaceous.—M. Sintsoff has contributed to the Novorossian Society of Naturalists, at the University of Odessa, a monograph of the sponges from the chalk of Soratoff. He describes a number of new species and four new genera. The same author has also a paper on Mesozoic fossils from Simbirsk and Saratoff in which he describes two species of Ammonites, *Aporrhais striatocarinata*, and several other mollusca.

Tertiary.—M. Sintsoff has described several tertiary mollusks of Novorossia, including species of Dreissena, Hydrobia, Neritinia, Valvata, Trochus, Amnicola, and Phasianella.——M. Cotteau has determined twenty-one species of Echinidæ from the tertiary strata of St. Valois (Seine Inferieure). Eight of these

have been found at other localities, in the Lower Eocene. Among the most interesting of the peculiar forms the author mentions *Goniopygus pelasgiensis*, the last representative of a genus abundantly diffused in the various stages of the cretaceous; *Salmondia archiaci*, which d'Archiac had erroneously united with *Echinocyamus subcaudatus* of the tertiary of Antibes (Var), but which differs from that species in the constant position of its periproct and other characters; and *Gualtiera orbignyi*, a type remarkable for its ovoid, posteriorly truncated form, by the arrangement of its ambulacral areas, which are severed at two-thirds of their length by an internal fasciole, and above all, by the protuberances which surround the peristome, and are prolonged along the center of the posterior interambulacral area. For these strata echini predominate, and other fossils are represented only by a few mollusks.——Mr. Thomas has recently studied the terrestrial and lacustrine tertiary and quaternary beds of Algeria, and has established several horizons, well characterized by the numerous fossils contained in them. Mr. Thomas has found some new mollusks, but has given his attention principally to mammals and has enriched palæontology with many new species. Among these is a Cynocephalus, three species of antelope, and a hipparion, the bones of which were associated with those of the horse, instead of preceding it, as is the case in Europe. All these are from the Pliocene.

Quaternary.—In the quaternary of Algiers, Mr. Thomas has found numerous flint implements, and remains of various animals. These include a rhinoceros, which, to judge from a molar, is *R. tichorhinus*, *Bubalus antiquus*, the horns of which measured ten feet between the points; *Bos primigenius mauritanicus*, two antelopes, a sheep, a mouflon, a camel nearly related to the dromedary, and an ass (*Equus asinus atlanticus*), which, in its dentition preserves some resemblance to Hippotherium.

MINERALOGY[1].

An Interesting Mineral from Canada.—The writer has given a preliminary notice of a very interesting mineral from Wakefield, Ontario, Canada. It occurs as white or grayish-white square crystals, sometimes an inch in breadth, and often glazed on the outside. They are nearly square prisms with truncated corners, the general appearance being that of a partly altered scapolite. They are tetragonal, with $O \wedge 2 = 129\frac{1}{2}°$. The angles, as pointed out to the author by Professor E. S. Dana, are closely similar to those of *sarcolite*, the following planes being identified: O, i-i, I. 2, 2-i, 2-2, 6-3, the last two hemihedral. The mineral

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Proceedings Mineralogical and Geol. Section, Acad. Nat. Sciences, Nov. 26, 1883.

ERRATA.—Through a mistake, the mineralogical notes in the NATURALIST of February were sent to press without any proof-reading; as a consequence numerous errors crept in, which are here corrected:

On p. 182,	line	9,	for gruelinite	read gmelinite.
"	"	10,	" pativis	" portions.
"	"	11,	" gruelinite	" gmelinite.
"	"	13,	" scaleushedron	read scalenohedron.
"	"	18,	" SO_2	" SiO_2, and for F_2O_3, Fe_2O_3.
"	"	19,	" S_9O_{26}	" Si_9O_{26}.
"	"	20,	" gruelinite	" gmelenite.
"	"	23,	" U.	" W.
"	"	28,	" λ	" $\wedge$
On p. 183,	line	12,	for mineral	" minerals.
"	"	17,	" bytainite	" bytownite.
"	"	31,	" stibrite	" stibnite.
"	"	43,	" racognized	" recognized.
On p. 184,	line	22,	" idoclase	" idocrase.
On p. 185,	line	19,	" Friederich's	" Friedrich's.
"	"	28,	" Larger	" Large.
"	"	36,	" alterative	" alteration.
"	"	45,	" Prechi	" Precht.

appears to bear the same analogy to sarcolite that gehlenite does to meionite. The crystals are distinguished by an almost entire absence of cleavage. Hardness 5–6, spec. gravity 3.050–3.057. Luster vitreous to resinous. The composition, as determined by Mr. R. Haines, is as follows, the enclosed calcite being subtracted from the analysis:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	P_2O_5	H_2O	
36.74	19.79	1.33	38.16	.77	.17	.32	2.49	.23	= 100

From this the quantivalent ratio of basis to silica is calculated as 9 : 6 or 3 : 2, thus placing the mineral among the subsilicates.

The mineral is insoluble or only partially soluble in acids, but gelatinizes with them after ignition.

Before the blowpipe it fuses at 3 with intumescence to a white glass. With the fluxes a slight reaction for iron is obtained.

A thin section examined under the microscope shows an admixture of calcite, which causes momentary effervescence when the mineral is placed in acid. The ground-mass is a gray amorphous, non-refracting substance resembling altered feldspar. Scattered through this are the unaltered crystalline fragments of a colorless, transparent tetragonal mineral, doubly refracting except in sections across the axis. The whole appearance resembles that of certain specimens of melilite, and shows alteration to have occurred hroughout the whole of the crystals.

The microscopic characters are not those of a simple mineral. Dr. M. E. Wadsworth regards the colorless mineral (isotropie or tetragonal) as having replaced the gray amorphous substance, as though the latter had once occupied the entire space.

The crystals are imbedded in blue calcite, and are associated with pyroxene, graphite, cubical spinel (see below) and other minerals. They were given the author by Dr. A. E. Foote, who obtained them from the locality.

The species appears to be isomorphous with sarcolite, but its very different physical and chemical characters indicate either a distinct species or a pseudomorph. The absence of cleavage and the heterogeneous microscopic characters argue pseudomorphism. Chemically it is allied to gehlenite. The temporary name *cacoclasite*, referring to its imperfect cleavage, was suggested. The specimens are still under investigation.—*H. C. Lewis.*

Cubic Spinel.—Close to the locality where the above mineral was found, were cubes of a hard, dark mineral, the corners of which were truncated by small, brilliant, octahedral planes. The cubes were frequently an inch in diameter, and the cubic faces were striated and often curved, the edges also being convex. The polariscope showed that the mineral was isometric. Externally the crystals were nearly black, and were frequently covered with a film of iron oxide. Small fragments were transparent, and by transmitted light black or smoky sea-green or bluish-green color, rarely smoky amethystine. It scratched quartz, and as shown by

the following analysis, was evidently a true spinel of novel crystalline form:

SiO_2	FeO	CaO	MgO	Al_2O_3 (by difference)	
0.65	3.00	1.20	27.18	67.97	= 100

—*H. C. Lewis.*

THE ORIGIN OF THE DIAMOND.—W. H. Hudleston[1] has advanced an extraordinary theory to account for the origin of the diamonds of South Africa. As is well known, the diamonds occur in a sort of soft, earthy breccia, made up of fragments of many kinds of rocks, and evidently of comparatively recent origin. A great part of the enclosed pebbles consist of basalt and other igneous rocks. Pieces of coaly matter and fossil shells also occur in the diamantiferous breccia, the matrix of which is a soft hydrated ferro-magnesian silicate. Dykes of dolerite, gabbro andother intrusive rocks form the walls of the diamond-bearing formation. The author believes that it is certain that the whole of the matrix *flowed upwards*, and that "it is impossible to doubt the *eruptive* character of the diamond rock." He thinks that superheated steam was the eruptive agent, and suggests the analogy of mud volcanoes.

Since no diamonds have been found except in this soft breccia, he suggests that the diamonds were formed in the breccia itself having been formed at a considerable depth and then carried upward with "the rise of the viscous fluid in the pipe." The carbon is supposed to have been derived from certain carbonaceous shales, which were distilled under enormous pressure, when the carbon would have "no choice but to assume the crystalline form."

Certainly this theory requires more evidence than has yet been presented to support it.

URANOTHORITE.—In 1876 Nordenskiöld found crystals of thorite at Arendal, Norway, having the form of zircon, and containing some ten per cent of protoxide of uranium. The same mineral was afterwards found by Lindström at Hitterö, Norway, and in 1880 an identical substance was found by Collier in the region of Lake Champlain, and called by him *uranothorite*, supposing it to be a distinct species.

Collier regarded the uranium as combined in the form UO but as L. F. Nilson believes,[2] this was a mistake, the uranium existing as UO^2. Now Zimmerman has proved that the uranium in the Norwegian thorite corresponds to UO^2, and the thoria to ThO^2, and that the two oxides replace one another in variable proportions. The mineral of Arendal is, therefore, but a variety rich in uranium of the thorite of Brevig, which was analyzed by Berzelius in 1829.

As the properties of the Lake Champlain mineral are identical with those of the Norwegian thorite, there is no reason for the name *uranothorite*.

[1] *Mineralogical Magazine*, Vol. v, No. 25, p. 199.

[2] Ann. d. Chimie et Physique, Nov. 1883, p. 429.

TOPAZ IN NEVADITE FROM COLORADO.—The "nevadite" o Chalk mountain, Colorado, is a porphyritic rock showing large glassy sanidine and many smoky quartz crystals imbedded in a grayish ground-mass, and is an eruptive rock, of probably early Tertiary age. Mr. W. Cross finds in certain druses very perfect crystals of colorless, transparent topaz. Although these crystals are very small (½ to 3 millimeters in length), they are interesting on account of their occurrence in an eruptive rock, all previously known occurrences being in granite, gneiss or some other metamorphic rock. In the present case, as indicated by the associated minerals, the topaz may be a sublimation product.

TELLUR-SULPHUR.—There has long been recognized in Japan, as being distinct from ordinary sulphur, a full orange-red variety under the name of seki-rin-seki (massive red sulphur). This has been examined by E. Divers and T. Shimidzu,[1] who find that while it is allied to the selen-sulphur of the Lipari islands, Naples and Hawaii, it differs from it in composition, being a tellurium sulphur. Analysis yielded

Te	Se	As	Mo	S (by diff.)
0.17	0.06	0.01	trace	99.76

When the tellurium sulphur was treated with carbon bisulphide, the arsenic remained as sulphide. This red sulphur appears to occur at all the deposits of volcanic sulphur in Japan, having been found at a number of localities. It contrasts strikingly with the associated yellow sulphur. It would be of interest could the chemical state of the tellurium be determined. Meanwhile the mineral may be regarded as a variety of sulphur, and might be known as *tellur-sulphur*.

AMERICAN GEMS.—Some very beautiful tourmalines, of varying shades of color and of unusually perfect crystalline form, have been recently found at Auburn, Maine. The colors are pale shades of blue, green and pink, all these shades often present in the same crystal. Mr. W. E. Hidden describes their crystallographic form, which is of unusual interest. A number of other minerals occur at the same locality, which promises to be of financial importance regarding the production of material for gems.

A new locality for emeralds has been found in North Carolina, about a mile south-west of the locality now worked at Stacy point. The crystals are pale-green, and occur in decomposed black mica, associated with quartz, rutile and hiddenite. Mr. J. F. Kunz states that this new locality shows that the deposit of emeralds in North Carolina is not an accidental one, and that there is encouragement for future exploration for gems in that State.

MINERALOGICAL NOTES.—During the year 1883 *sixty millions of pounds of copper* were extracted from the Lake Superior mines. ——*Ozokerite* has been found in the Island Tscheleken in the

[1] *Chem. News*, Dec. 21, 1883.

Caspian sea. It is a brownish-black, sticky mass, almost entirely soluble in boiling benzine. On extracting it with ether, a hard residue remains, which contains a paraffine whose melting point is 79°, and sp. gr. 0.939. This paraffine forms lustrous crystals and is very stable. It has been named *leken.*——*Celestite* has been found in three localities in Kansas, as announced by W. Knaus in the *Kansas City Review.*——A remarkably fine group of Japanese *stibnite* crystals has been recently purchased for the British Museum. The group consists of 120 crystals from one-half to two and a-half inches wide and thirteen inches long, the whole weighing 150 lbs.——Lippitt has found a native ferrous and aluminum sulphate from Mexico, which was a compact mass of flexible fibers resembling asbestos, of a greenish-white color and silky luster, with a hardness of 2 and spec. grav. 1.89. It was soluble in water, and analysis indicated that it corresponded to a mixture of two molecules of halotrichite and one of melanterite. The iron was all in the ferrous condition.——*Vivianite* occurs in brilliant, dark-blue crystals in the cavities of human bones taken out of a supposed Roman well near the pyrites mines of Rio Tinto, Sierra Morena.——Professor M. F. Heddle has found *topaz* associated with thorite, magnetite, amazon-stones, etc., in the syenite of Ben Loyal, Sutherland, Scotland.——*Idocrase* of a greenish-yellow color, and of unusually interesting crystallographic form, occurs at Kedabék, in the Caucasus, according to O. Korn. It has been shown by Jannasch that the idocrase from Vesuvius, Norway and elsewhere contains one per cent or more of fluorine.

BOTANY.[1]

Glands on a Grass. — In the latter part of August, 1883, while collecting various plants, my attention was attracted by some minute insects which appeared to be held fast to parts of the slender pedicels of one of our drop-seed grasses (*Sporobolus heterolepis*). An examination, by means of a hand-lens, showed these unfortunate insects to be adhering to small, dark-colored glistening swellings of the pedicels. Further examination showed these swellings upon most of the pedicels, and their slight stickiness to the touch quickly suggested their glandular nature. They were accordingly taken to the laboratory and carefully studied.

Upon making a cross-section of the swelling, the glandular tissue (*a*) was found to be disposed upon two sides of the section, with green tissue (*b*), and the fibrovascular bundles (*c a*) and their accompanying masses of fibrous tissue (*e e*) occupying the remaining and interior parts, as shown in Fig. 1, of the accompanying camera sketches.

A higher power of the microscope showed the glandular tissue

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

to be made of columnar radially-placed cells, which, from their relation to the contiguous tissues, are clearly to be regarded as modified epidermal cells. They were filled with minutely glandular contents (Figs. 2 and 3, *a*) of a faint amber color. Beneath the gland-cells there are several layers of chlorophyll-bearing cells (*b*).

A superficial view of the gland-cells showed them to be irregularly prismatic (Fig. 4). The outer walls are much thickened, as are also the lateral walls for some distance from the surface, these becoming gradually thinner as they pass inward, as shown in Figs. 2 and 3. For comparison, a superficial view of the ordi-

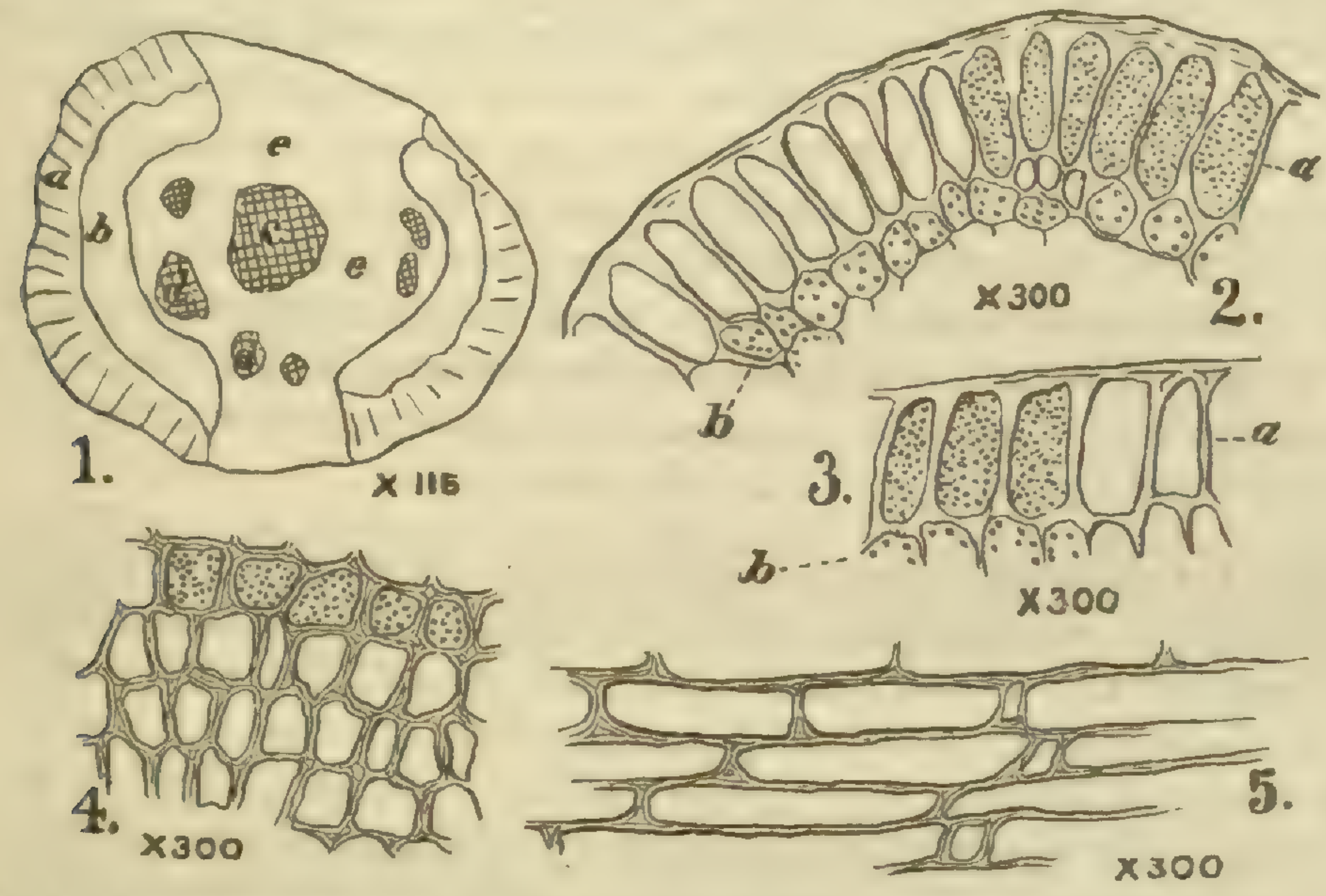


FIG. 1.—A cross-section of a glandular swelling; *a*, gland cells; *b*, green cells; *c*, and *d*, fibrovascular bundles; *e*, fibrous tissues. FIG. 2.—Cross-section of gland cells, *a*, and green cells, *b*. FIG. 3.—Longitudinal radial section of same. FIG. 4.—Superficial view of gland cells. FIG. 5.—Superficial view of ordinary epidermal cells of the pedicel, taken just above the glandular swelling. From camera lucida sketches.

nary epidermal cells of the pedicel, taken just above the glandular swelling, is here reproduced in Fig. 5.

These glands remind one, in their position, of the sticky belts upon the pedicels of certain species of Catchfly (*Silene*) and one is tempted to ask whether they have not the same functions in both cases.—*C. E. Bessey.*

SEXUALITY IN ZYGNEMACEÆ.—A paper was read [before the Linnean Society, Nov. 15, 1883] by Mr. A. W. Bennett, on the reproduction of the Zygnemaceæ, as a solution of the question—Is it a sexual character? De Bary, twenty-five years ago, and since then, Wittrock, have instanced what they have deemed sexual differences between the conjugating cells, though most later writers rather ignore essential physiological distinctions. Mr. Bennett has directed his investigations chiefly to the genera Spi-

rogyra and Zygnema, and from these he supports the inference of the above-mentioned authors. He finds there is an appreciable difference of length and diameter in the conjugating cells, that deemed the female being the larger. The protoplasmic contents he also finds pass only in one direction, and change first commences in the chlorophyll-bands of the supposed male cells with accompanying contraction of the protoplasmic material. The genera Mesocarpus, Staurospermum, and the doubtful form Craterospermum have likewise been examined, and, though showing differences, yet on the whole substantiate the view above enunciated of cell sexuality."—*Nature.*

[In the case of hybridism in Spirogyra, described in the January NATURALIST, there were resting-spores in *both filaments.* The cell *A*, of the figure there given, was in the case of hybridism, functionally the male, but the next cell to the right contained a resting-spore, as is shown in the figure. Moreover, the right cell to the left of *B* [not shown in the figure] contained a resting-spore. This case would indicate that bi-sexuality must be confined in *A*, at least to individual cells, otherwise, we should have to consider this a case of conjugation between two female plants, which is manifestly absurd.—*C. E. Bessey.*]

SOME RECENT BOTANICAL ADVANCES.—Among the most significant of the recent discoveries in botany is that respecting the continuity of the protoplasm from cell to cell by means of delicate threads which traverse channels through the cell walls. It had long been known, that in the "sieve" tissues of higher plants there was such continuity through the "sieve plates," which imperfectly separated the contiguous cells. This may be readily seen by making longitudinal sections of a fibro-vascular bundle of a pumpkin stem, staining with iodine, and contracting the protoplasm by alcohol. Carefully made specimens of the soft tissues of many plants have shown a similar protoplasmic continuity where it had previously been unsuspected. Some investigators are now inclined to the opinion, that protoplasmic continuity may be of universal occurrence in plants.

Tschirch regards it as probable, that Chlorophyll plays "not merely a physical, but also a chemical part in the process of assimilation." This is in opposition to Pringsheim's view, that the function of chlorophyll is that of a screen or shade.

It has recently been suggested that the act of sexual conjugation, that is, the union of two masses of protoplasm, may be regarded as "simply a strongly specialized instance of the absorption of nutriment." According to this view, what we call fertilization, is but the feeding of a cell upon the richest possible food, *i. e.*, material identical with its own substance. This rich food enables the cell, so greatly nourished, to perform the work of reproducing a new individual.

Botany in a Medical Course.—From *Nature* we learn that a most excellent course of study in botany is required in medicine, in England, as indicated by the examinations under the new rules which took effect in January of this year. These examinations "will have reference to the fundamental facts and laws of the morphology, histology, physiology, and life-history of plants, as illustrated by the following types: Saccharomyces, Protococcus, Mucor, Spirogyra, Chara or Nitella, a Fern, Pinus, and an angiospermous flowering plant."

Is there any medical school in this country, where such an intelligently arranged course in elementary botany is provided? Too often, alas, there is no *botany at all* in our medical courses.

Obituary.—The friends of science, and mycologists especially, will learn with regret of the death of Wm. T. Haines, Esq., who died suddenly at his residence in West Chester, Pa., on the 2d of February, 1884. Mr. Haines, in addition to his arduous legal duties, has for many years taken a deep interest in scientific pursuits, and especially in the investigation of the flora of his locality; and the many interesting species contributed to the North American Fungi, by him and his colleagues of the West Chester Mycological Club, will long keep his name in pleasant remembrance among those who turn over the pages of that collection.—*J. B. Ellis.*

Botanical Notes.—A fine engraving of the foliage and mature cones of *Dammara australis*, the Kauri Pine of New Zealand, is given in the *Gardener's Chronicle*, for October 27th, last. The number for November 3d, contains well-drawn life-size figures of our Yellow-water lily (*Nuphar advena*).—The October *Quarterly Journal of Microscopical Science*, contains an extended article by H. M. Ward, on the genus Pythium, accompanied by three double-page plates. We hope to present a summary of this paper ere long.——A proposal has been made in England to celebrate the bi-centenary of the discovery of bacteria (by Leeuwenhoek, in 1683), by the endowment of a National laboratory of hygiene, in which the study of the bacteria shall be one of the principal objects.——In the January *Torrey Bulletin*, Mr. Schrenk contributes some notes on Tuckahoe, accompanied by a plate. The evidence now adduced seems to indicate that tuckahoe is due to a sort of gummy degeneration of the tissues of some plant, and that the fungal threads present are saprophytic; the accompaniment not the cause.——In the same journal several new grasses are described by Mr. Scribner. One by Dr. Vasey, is dedicated to the well-known collector, A. H. Curtis. It is from Florida, and is named *Ammophila curtisii*.——The February *Botanical Gazette*, is an unusually interesting number, containing among other papers, one on Schweinitz (biographical), a Botanical Holiday in Nova Scotia, Notes on the N. A. forms of Podosphæra,

Additions to the Habitats of N. A. Sphagna. The General and Editorial Notes are full, and well selected. Among these we notice the discovery of a grass, *Graphephorum festucaceum*, from Northern Iowa. It has hitherto been known only from the Saskatchewan region, northwestward to Alaska. This northern grass may well serve as a companion with *Adoxa moschatellina*, also a far northern plant found a few years since in Northern Iowa.——General Benjamin Alvord, publishes in the Bulletin of the Am. Geographical Society, No. 4, a valuable paper on Winter grazing in the Rocky Mountains. Its chief interest to us in this place is its discussion of the grasses of that region.——We fell into an error in our notice (in the February NATURALIST) of very simple prothallia of a fern (*Onoclea struthiopteris*) grown by D. H. Campbell. The autheridia were not one-celled, as we understood from the drawing and description, but several-celled.

ENTOMOLOGY.

THE SPRUCE-BUD TORTRIX.[1]—The habits of this insect while in confinement were first studied by Professor C. H. Fernald, of the Maine State Agricultural College, Orono, Me., and his account published in the AMERICAN NATURALIST for January, 1881. In the account of the ravages of a caterpillar on the spruces on the coast of Maine in Bulletin 7 of the United States Entomological Commission, we refer to this insect, which we were unable to identify, as, after repeated search in the latter part of the summer, we failed to discover any traces of the insect in any stages. In our account we gave greater prominence to the operations of borers and bark beetles than to those of this caterpillar; and while considerable damage was undoubtedly done to spruces and firs in Sagadahoc and Cumberland counties by those beetles, from farther inquiries and field-work carried on in June and July, 1883, in different parts of Maine, we now have little doubt but that the destruction of spruces and firs along the coast of the State was mainly due to the attacks of this insect.

The different climatic causes alleged to destroy forest trees in general, would, in the present case, have injured pines and hardwood trees, as well as spruces and firs, and the destruction would have been general; whereas the trees have been killed by a caterpillar which we have never found upon pines nor any trees but spruce, fir, and occasionally the hemlock and larch. Individual trees, or clumps of trees, were attacked, whether in high and exposed situations or in hollows; occasionally from such centers the worms seem to have increased and spread from year to year, until all the trees in localities several square miles in extent were killed. Moreover, as we have seen in the case of the attacks of

[1]Extracted from the report of the Entomologist (Professor C. V. Riley) of the Department of Agriculture for 1883.

the larch worm, the defoliation of spruces and firs repeated two and perhaps three summers is sufficient to either kill the tree outright, or so weaken it that bark-boring beetles can complete the work of destruction. We are now inclined to the opinion, then, that the bud Tortrix is the sole or at least main cause of the destruction of spruces and firs in Cumberland and Sagadahoc and Lincoln counties, Maine, and that by their attacks they render the trees liable to invasion by hosts of bark beetles.

The spruce-bud worm, as we observed in Cumberland county, also at Phillips, and near the Rangeley lakes, on the road from Phillips to Rangeley, where the trees by the roadside, as well as in the woods, were attacked by them, so that they looked as if a light fire had passed through them; feeds upon the leaves or needles of the terminal shoots, both the first and previous year's growth. The worm gnaws the base of the needles, separating them from the twig, meanwhile spinning a silken thread by which the needles and bud-scales are loosely attached to the twig; the worm moving about in the space between the twig and the loosened needles and bud-scales, and not living, like many leaf-rolling caterpillars, in a regular tube.

The caterpillar sometimes draws together two adjacent shoots, but this is rarely done; hence while it is at work it scarcely alters the appearance of the tree, and its presence is only known when the worms are abundant enough to partly defoliate the trees.

The worms in June, 1883, were in Cumberland county most abundant where the dead or partially dead spruces abounded; but individual worms could be obtained by beating any spruce or fir in any locality, showing that in years of immunity from its attacks the insect is a common and widespread species. We found the worms most abundant in spruces, firs, and even hemlocks, July 1 and 2, between Phillips and Rangeley, but after passing through all the Rangeley lakes, and going from Errol, N. H., to Berlin, Gorham, Jackson, and Conway, N. H., we found that the spruces and firs throughout Northwestern Maine and the White Mountain region had suffered no widespread damage. One and perhaps two rather extensive tracts of dead spruces were observed at a distance from the stage road near Rangeley, but throughout the vast spruce-clad forests observable from the lakes themselves, no such tracts of dead trees were to be seen. On the contrary, the spruce forests of the Rangeley Lake region appeared to be as green and fresh as any forest we have ever seen. The dead spruces at the water's edge of the middle lakes were evidently due to the high water held in by the middle and lower dams during the last two years. As in any forest, there were individual dead trees, sometimes small clumps of them, where the trees had died as the results of tornadoes or of borers. The persons living by the lakes, lumbermen and others, informed us that there had been no extensive destruction of evergreen trees in this region.

The spruce-bud worm attains its full size and stops feeding, ready to transform to a chrysalis, in Cumberland county, by the 20th to 30th of June, and about the Rangeley lakes and in the White Mountain region a few days or nearly a week later.

When about to change to a pupa it remains in its rude shelter or hiding-place under the loosened leaves of the shoot, where it turns to a chrysalis, without spinning a regular, even, thin cocoon. It remains in the chrysalis state about six days. Those pupating at Brunswick, Me., June 28 and 29, issued as moths July 4 and 5. When the moth is ready to break forth from the pupa, the latter wriggles part way out of its hiding-place, and the moth issues, leaving the rent pupa skin projecting half way out of the end of the shoot. The moths then appear from the first to the middle of July. July 16, after our return from an absence of two weeks, we found that the moths of both sexes had issued, and that the females had laid their eggs in curious little patches on the sides of the breeding-box. They must have issued about the 5th to the 7th of July, and immediately laid their eggs, as in one patch the shells were empty, with a small orifice in the shell, out of which the larvæ had crept. Another patch was found with a dark spot in each egg, showing the head of the embryo caterpillar; these hatched July 18, 19. It thus appears that the embryo develops, and the caterpillar hatches, in about ten days after the eggs are laid.

The eggs are very curious and very unlike those of most moths. They are pale-green, scale-like, broad, flat beneath, moderately convex above, oval cylindrical, a little longer than broad, and in all those which I examined, both those containing the embryos, and those which were empty, the surface, contrary to Professor Fernald's statement, was under a lens seen to be finely but irregularly granulated. The shell is thin, and at first unusually soft. Length, 0.9–1.4^{mm}; breadth, 0.8–1^{mm}. The patches were about 3^{mm} in diameter, and composed of as many as 30 eggs. The eggs overlapped each other irregularly, leaving about a third or fourth of the surface of each egg exposed.

From the form and size of the egg-mass it is evidently attached by the moth to a terminal twig. The caterpillars on hatching do not, as Fernald observes, eat the shell. They hatch about or soon after the middle of July, and it is most probable that the caterpillars become partly, perhaps almost wholly, grown before the end of autumn, and pass the winter among the terminal shoots of the tree, to finish their transformations the following June and July. It is certain that there is but a single brood of caterpillars. Professor Fernald, in his article in the AMERICAN NATURALIST, describes the process of egg-laying. He has bred from the worm an ichneumon (*Pimpla conquisitor*), several dipterous parasites and a hair-snake. We have found the insect to be remarkably free from parasites, having bred about 25 of the moths without rearing any parasites.—*A. S. Packard, Jr.*

Nest of the Pseudo-Scorpion.—In confirmation of the reference to this subject in "Packard's Guide to the Study of Insects," fourth edition, p. 658, I found, Feb. 5, 1884, a pseudo-scorpion, which had died in its nest, in the act of molting. The nest was made at the edge of a piece of paper lying on a beam in a garret. When the paper was removed, the nest still adhering to the edge, had its lower surface torn open, disclosing the dead insect. The nest (Fig. 1, under side, nat. size; Fig. 2, upper side, enlarged five diameters), was oval in outline, two-tenths of an inch long. Its lower surface was a flat, white web of extremely thin, translucent texture. Its upper surface was slightly convex, firmer and darker than the lower, and the entire edge was bordered with minute pieces of sawdust, firmly glued to the web. The insect was about half withdrawn from its old integument (Fig. 3, view from above; Fig. 4, view from the side, both enlarged five diameters).

Pseudo-Scorpion's nest.

Fig. 1.—Under side of nest, nat. size. Fig. 2.—Upper side of nest, enlarged. Fig. 3.—Pseudo-scorpion view from above. Fig. 4.—Do. view from the side.—*J. L. Zabriskie.*

This molted covering was entire, although wrinkled on the back, reaching nearly its original position at the head; but underneath it was ruptured on each side, from the head backwards to about two-thirds of its length, somewhat resembling a pair of opening oyster shells. The empty coverings of the large maxillary palpi were extended, in perfect condition, still bearing the prominent long hairs on the forceps. But the molted palpi themselves were bent downwards and backwards, with their tips extending under the abdomen, where also all the legs were gathered with their tarsi placed together.—*J. L. Zabriskie, Nyack, N. Y.*

Entomological News.—*Papilio* closes its third volume with an excellent triple number. The transformations of *Hemaris uniformis*, *Darapsa charilus*, *Cressonia juglandis*, *Sphinx chersis*, *Paragmatobia rubricosa*, *Deiopeia bella*, *Parasa chloris*, *Limacodes scapha*, *Adoneta spinuloides*, *Gluphisia trilineata*, *Notodonta stragula*, *Œdemasia concinna*, *Cerura cinerea*, *Tolype velleda* and *laricis* and several Noctuids, with the geometrid *Amphidasis cognataria*, are described by H. Edwards and S. L. Elliott. Mr. H. Edwards limits the species of Euchetes, and shows by Mr. Elliott's observations on the larvæ, that *E. collaris* is a different species from *E. eglenensis*. The genus Arctia and its variations are discussed by B Neumogen with the result of reducing several so-called species to varieties. Mr. W. H. Edwards comments at length on Hagen's views on the genus Colias; while W. Schaus, Jr., de-

scribes the early stages of some Mexican Lepidoptera. We regret to notice that Mr. Edwards is unable to conduct this very successful journal, which will hereafter be published by Mr. E. M. Aaron, P. O. Box 2500, Philadelphia, Pa.——An elaborate essay on the thoracic muscles of insects, by C. Luke, appears in the Jena *Zeitschrift*, for Oct. 13, '83. With the exception of the Thysanura (including the Collembola) insects of all orders have been examined.——The Quarterly Journal of the Boston Zoölogical Society, for Jan., prints valuable notes on the habits and metamorphoses of *Hydrocharis obtusatus* and *Magdalis olyra*, by F. C. Bowditch.——Dr. Hagen states in the *Entomologist's Monthly Magazine*, for Jan., that he saw at Wood's Holl *Anax longipes* preying upon *Papilio asterias*, catching them and settling on a shrub to behead and devour them. This is a rare southern form. ——A case of sex-dimorphism in the Psocidæ is noticed by Ph. Bertkau (Archiv. für Natur., 1883). In *P. heteromorphus* the wings of the male are long, while those of the female are short. In *Trocticus gibbulus*, n. g. and sp., the wings are short in both sexes. *Lapithes pulicarius* is a wingless Psocid, which differs from other wingless genera in the antennæ, palpi, and maxillæ. Dr. Otto Geise (*loc. cit.*) gives a minute description of the mouth parts of the Rhynchota, as exemplified by *Notonecta glauca*, *Nepa cinera* and *Corixa striata*.——H. J. Kolbe. (Archiv. für Natur., 1883) characterizes forty-three species of Dytiscidæ from Madagascar, in the entomological museum of Berlin, and diagnoses twenty other species found in Madagascar, as well as six found on the surrounding islands only. The usual world-wide genera occur in Madagascar, but numerous small species are peculiar. Genera, not common to Madagascar and the Oriental region, do not occur in Australia. The genera *Bidessus* and *Copelatus*, which are probably oldest phylogenetically, are most abundant in Australia, and occur but sparsely in Asia, Africa, and Madagascar. Most of the genera are richer in species in Madagascar and the Oriental region than in Africa. The smallest species are nearer to those of the Oriental and Australian fauna, than to those of Ethiopian; and, on the whole, the Dytiscidæ of Madagascar are nearer those of the two former faunæ than they are to those of the latter.——Mr. G. C. Chapman relates in the *Entomologist's Monthly Magazine*, for January and February, his interesting experiences during four years' collecting in Central America, where he obtained not less than 15,000 species of insects, the greater part of which will probably be catalogued in Godman and Salvin's Zoölogy of Central America.——Obituary notices of the late Dr. John L. LeConte, by Professor J. P. Lesley and Dr. Horn, were read before the American Philosophical Society; in the latter's notice it is stated that LeConte described more than 500 genera and nearly 5000 species, three-fourths of the latter remaining valid; but, it is added, that his work was notable for his breadth of view as well as analytical powers.

ZOÖLOGY

TREMATODE PARASITES IN AMERICAN CRAYFISH.—Professor Kellicott has recently called attention to the fact that American crayfish are subject to invasion by Trematode parasites.[1] His remarks have recalled to me some observations which I made in 1879, and which I now record, because in the interval the Distomes of the European *Astacus fluviatilis* have been subjected to renewed examination,[2] and one of them has been accused as the cause of the pest, which has, within the last five years, effected such ravages in the crayfish tanks of France and Germany.

Two Distomes are found abundantly in Astacus—*D. isostomum* Rudolphi, and *D. cirrigerum* v. Baer. The former lives free in the body cavity, is immature, measures between 2 and 3^{mm} in length, and is immediately recognized by the equality in diameter of its anterior and ventral suckers. According to Harz, it is harmless to its host, and Zaddach thinks that it is developed from the eggs of *D. cirrigerum*.

It is my impression that I have also met with *D. isostomum* in American crayfish, but the only specimens I have preserved are from Germany.

D. cirrigerum is always encysted, is most abundant in the muscles of its host, and produces, according to Harz, the crayfish pest, which has consequently been styled a "Distomatosis." Zaddach, v. Linstow and other observers contest this view, believing that, after encystment, the Distomes can occasion little or no inconvenience. Although an encysted form, *D. cirrigerum* produces eggs, and is, of course, self impregnating. The minute encapsuled forms described by Professor Kellicott, are very probably young stages of this species.

In my collection of Trematoda, I find one which I marked, when discovered, "*D. nodulosum* Zeder, from a cyst in the ovary of Cambarus," probably *C. propinquus*. This species (Fig. 1), belongs to a small group of Distomes in which the anterior

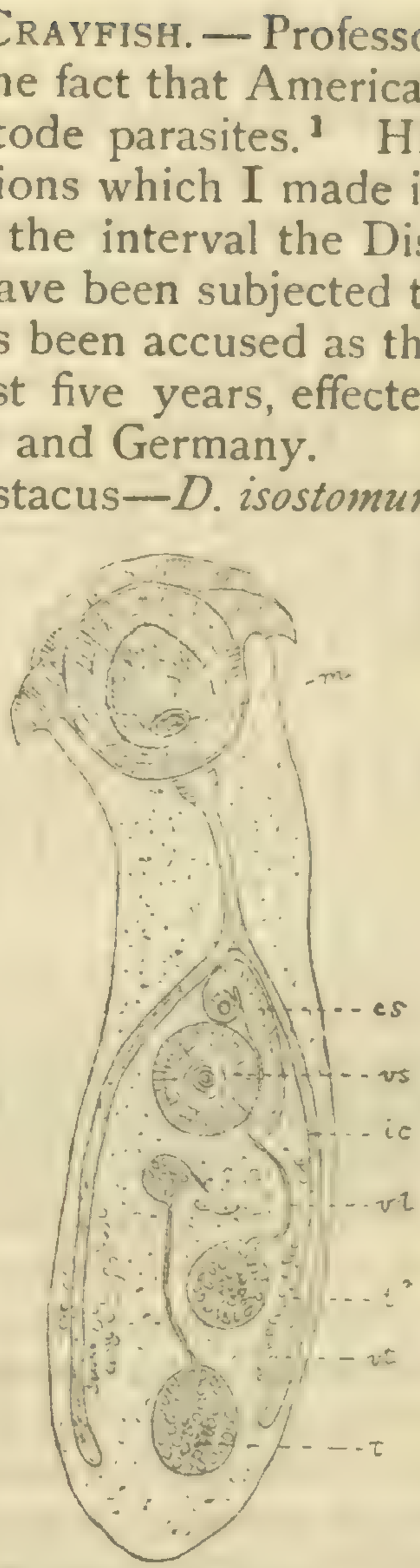


FIG. 1.—*M*, the mouth in the anterior sucker; *cs*, the sac of the cirrus opening in front of *vs*, the ventral sucker; *ic*, one of the intestinal cœca; *vd*, vas deferens leading directly from the anterior testis *t'* to *cs*; *vt*, the vitellogen; *t*, the posterior testis, the vas deferens of which appears to end in a vesicula seminalis, between which and *vd* is the blastema for the ovary.

[1] Proc. Am. Soc. Microscopists, Chicago Meeting, 1883, p. 115.

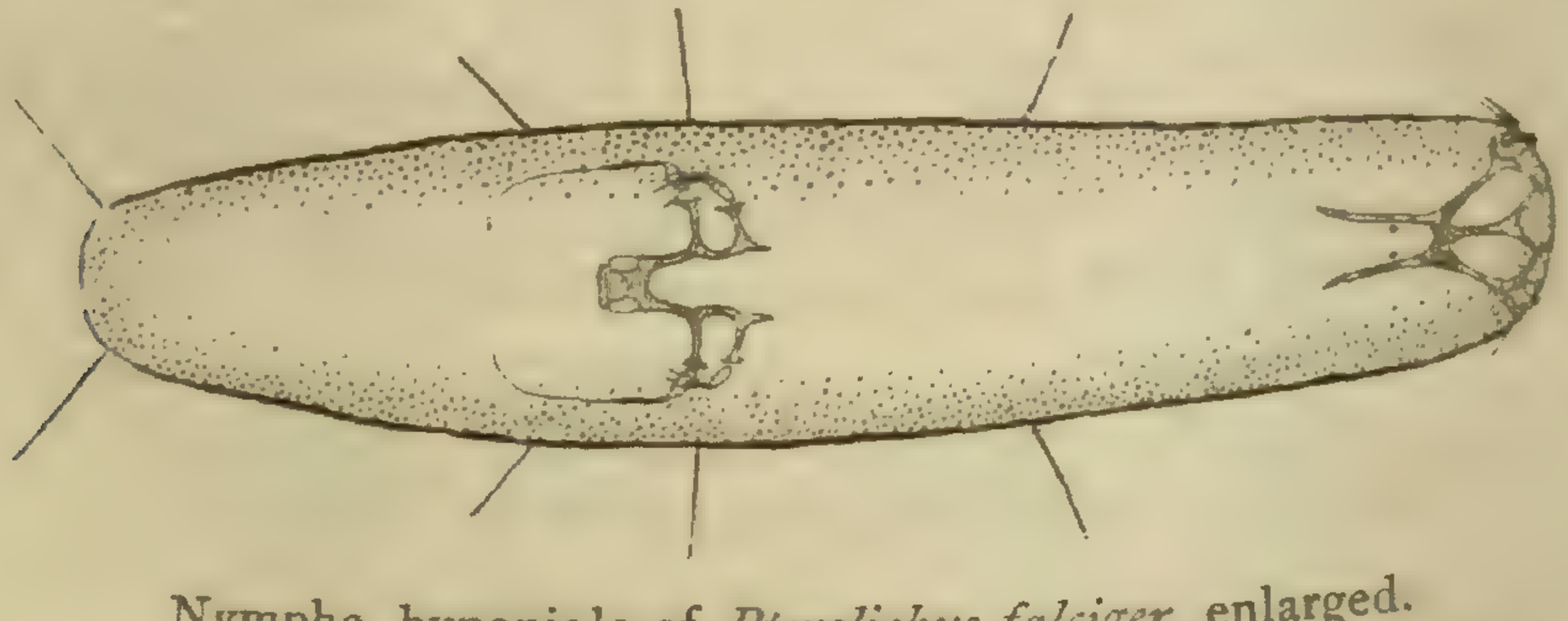
[2] C. O. Harz. "Die sogenannte Krebspest, &c." Wien, 1881. Rev. by Dr. v. Linstow in Bericht über nied. Thiere in Archiv. für Naturg., 1883.
G. Zaddach. Zoöl. Anz., 1881, 398 and 426.

sucker is produced into papillæ, and is found free in the intestinal canal of various European fresh-water fish (Perca, Lucioperca, Esox), and encysted on the outer surface of the intestine in Acerina. V. Linstow[1] indicates *Paludina impura* as the intermediate host into which the cercariæ of *D. nodulosum* penetrate and encyst themselves. Their presence in an encapsuled condition in Acerina he explains by supposing that the cercariæ have either wandered directly into the little fish, or that they have been swallowed while still free in the mollusk.

My specimen resembles the encysted state from Acerina in the fact that only the male organs are developed, the few female organs being undifferentiated. The structure of the mouth suckers is not entirely in accordance with v. Linstow's description. As far as I can make out from my only specimen, the periphery of the sucker is prolonged at the sides anteriorly into two somewhat triangular flaps, and its muscular wall is pushed out in front into four papillæ.

I have not met with *D. nodulosum* as a fish parasite, but it is probably to be found mature in the intestinal canal of various fresh-water fish. It remains to be seen whether the crayfish is normally the intermediate host. The researches of the late Professor Ercolani[2] have shown how easily some Trematodes accommodate themselves to new surroundings, and it is quite possible that this solitary specimen of *D. nodulosum* had merely "wandered" into an unaccustomed host.—*R. Ramsay Wright, School of Practical Science, Toronto.*

PTEROLICHUS FALCIGER MEGNIN, OBSERVED IN THE UNITED STATES.—The "nymphe hypopiale" (*Hypoderas columbæ* Murray) of this mite has been noticed by the writer on several occasions in the tissues of the domestic pigeon. As stated by Robertson, it occurs most abundantly in the connective tissue about the large veins near the heart, but a few may be found under the skin in the region of the arm-pit. It is an elongate, sack-like, whitish body, about 1.5^{mm} long, with smooth surface, and very short legs, the two anterior pairs of which are widely separated from



Nymphe hypopiale of *Pterolichus falciger*, enlarged.

the two posterior pairs. No mouth-parts are visible with one of

[1] Arch. für Naturg., XXXIX, 1873, p.

[2] Dell' adattamento della specie all' ambiente. Bologna, 1881–2.

Spencer's 1-10 inch immersion objectives, and as these appendages can be seen with ordinary objectives in very much smaller mites than this, it is safe to assume that there are none. The character of the legs, with their chitinous rings and highly-developed epimera, would seem to be sufficient to place this form with the Sarcoptidæ, even if none of the other stages existed. The legs are not terminated by two hairs, as is supposed by some writers, but in the three anterior pairs by a long claw with a slightly swollen tip, which probably represents the tarsal sucker of the normal form.—*H. Garman.*

On the Morphology of the "Lateral Rods" of the Ophiuroid Pluteus.—Two groups of Echinoderms, the Ophiuroidea and the Echinoidea, have a larval stage in their development, which is known as a pluteus. In both of these groups the larval appendages, unlike those of the young of other Echinodermata, have the form of long calcareous rods, encased in a covering like that which forms the fleshy walls of the body.

Homologues of all these appendages or rods of the Ophiuran pluteus have been found in those of the Echinoid, with the exception of by far the most prominent pair, which is first to appear and last to be absorbed and known at the lateral arms.[1] These are not commonly mentioned as existing in the pluteus of the Echinoid genera, and many authors say that they are unrepresented. On the other hand a pair of appendages, which seems to be without homologues in the pluteus of the Ophiuran, exists in the pluteus of certain genera of Echinoidea, as Arbacia, and are called the "apical" or "anal" rods or appendages. The lateral rods of the Ophiuran larva bear so many resemblances to these so-called anal appendages of Arbacia, that it seems natural to homologize the one pair with the other.

A new pluteus from the Bermudas, a description of which I hope later to publish, seems to stand intermediate between that of Arbacia and the young Ophiuran in respect to the size, and comparative development of the lateral or apical arms It supports in all particulars the homology of these two appendages which I have pointed out above.

The relative time at which the development of the lateral arms in the pluteus of Ophiurans takes place, and that when the apical rods of Arbacia develop, may not seem to support the theory which has been advanced in regard to their homology. The lateral rods of the Ophiuran pluteus are among the first of these appendages to develop, while the posterior pair of arms in Arbacia are well developed, and the so-called antero-lateral are far along in growth, before any trace of the apical rods appears. This order of development would seem a fatal objection to the pro-

[1] The nomenclature of the arms adopted here is that used by Balfour in his Comparative Embryology, Vol. I, page 470.

posed morphological identity of the two, if the time of their appearance is the only index of homology in Echinoderm larval appendages. The comparative anatomy of the rods of the body of the pluteus seems to me to point without doubt to an homology of the lateral arms of Ophiuran larval and the apical rods of Arbacia. All the appendages of the various forms of Echinoderm larvæ may be regarded as specially, or perhaps independently acquired structures, which are destitute of any great value, comparatively speaking, as far as the phylogeny of the Echinoderms is concerned. If I am right in looking at them in this way, the stages of growth in which the larva of Arbacia and the Ophiuran was, when on the one hand an apical [1] pair of rods, and on the other the lateral arms appear, need not coincide and yet the two may be homologically the same.—*J. Walter Fewkes.*

PLATEAU'S RESEARCHES ON THE ABSOLUTE FORCE OF THE MUSCLES OF BIVALVES.[2]—The great *apparent* force of the adductor muscles of lamellibranch mollusks is a fact universally known, and which forms the basis of La Fontaine's fable of the rat and the oyster. Fishermen and naturalists have made this the subject of interesting remark. Thus Darwin, speaking of the great Tridacnas of tropical seas, says, that any one imprudent enough to introduce his hand between their valves, would be unable to withdraw it while the animal lived. Léon Vaillant relates that the divers whom he employed at Suez, and who procured him specimens of *Tridacna elongata*, advised him not to touch these animals on the side of the opening of the shell.

Plateau then adds: "I myself, in the course of experiments related in this notice, have been witness, whenever I wished to, in *Mya arenaria*, of a fact at first sight very surprising; if in the living mollusk we break, with the aid of a knife or forceps, a small area of the shell in the neighborhood of the hinge, a cracking noise is heard, and we see the valves open and striking together with a loud noise under the influence of the traction of the adductor muscles."

Darwin's observations on the transportation of Unio suspended by its closed valves to a duck's foot; of a Cyclas fixed in the same way to the foot of a water-beetle (Dytiscus), and of Cyclas attaching itself to the foot of a triton so as to amputate it, are noticed before speaking of the observations of others who submitted the adductor muscles to experiment.

Noticing A. Fick's experiments on the elongations, etc., which the adductor muscles of Anodonta; those of L. Vail-

[1] From what has been said it is thought proper to suggest the name lateral rods to designate these appendages as well as their homologues in the Ophiuroid for which it has long been used.

[2] Recherches sur la force absolue des muscles des invertebrates. Prem. Partie. Force absolue des muscles adducteurs des mollusques Lamellibranches. Par M. Professor Felix Plateau. Extrait du Bulletins de l'Academie royale de Belgique, VI. 1883, 8vo, pp. 36.

lant on the measurement of the force displayed by the adductors of bivalves, he refers at some length to those of A. Coutance, made especially on the *Pecten maximus*.

Plateau then describes at length his own interesting experiments, from which he draws the following conclusions:

1. The only way to carefully compare the muscular force of lamellibranch mollusks with that of the higher animals consists in estimating the absolute forces of the muscles by the square centimeter of transverse section.

2. The result of this comparison shows that the absolute force of the adductor muscles of Lamellibranchs is analogous to the absolute force of the muscles of vertebrates. The reader will probably make the remark that the fibers of the adductor muscles of the bivalves are generally smooth, while the muscles of animal life of vertebrates are composed of striated fibers. The objection is a serious one; but with the result to place me in the best possible condition, since I have undertaken some researches of the same kind on the Crustacea. The muscles of these articulates are striated, and present a texture very near to that of vertebrates.

Three New Families of Fishes added to the Deep-Sea Fauna in a Year.—In addition to the family of Eurypharyngids, fully described lately by Mr. Ryder and myself, two new family types were added to the deep-sea fauna by the explorations of the U. S. Fish Commission on steamer *Albatross* in 1883. These will be called Derichthyidæ and Stephanoberycidæ.

The Derichthyids are represented by one specimen, which has an eel-like form, a serpentiform head, with *well developed maxillaries*, as well as palatines, both bearing bands of teeth, a *well defined neck*, and the scapular arches remote from the skull. The color is a ruddy brown. Mr. Ryder and myself will describe the form at length under the name *Derichthys serpentinus*. It appears to be the type of a new order, and is especially interesting as being the only fish (so far as I recollect), with a true neck. Some may urge Hippocampus as a necked fish, but the doing so would be quite improper, for the contracted portion is behind the pectorals.

The Stephanoberycides appear to be Berycoidea, with abdominal or subabdominal ventrals, a dorsal of articulated rays, a caudal with numerous spinous rays in the procurrent upper and lower extensions, a cavernous head, toothless palate, and scales with spinous surfaces. It includes my *Stephanoberyx monæ* and *Acanthochænus lütkenii;* the latter has abdominal ventrals and branched rays, thus differing from Stephanoberyx, but it is not absolutely impossible that it may prove to be merely the mature form of the other, which was based on a small specimen.

Another interesting fish, from the same collection, is an Alepocephalid, with the body as well as head scaleless, which I shall describe as *Aleposomus copei.*—*Theodore Gill.*

ZOOLOGICAL NOTES.—Dr. C. Bulow (*Archiv. für Naturgeschichte, 1883*) gives the result of experiments on the subject carried on by him at Rostock. Bonnet beheaded a worm eight times, and regeneration followed each time, but the ninth time only a bud appeared. The results obtained by Reaumur, O. F. Müller, and others, are recapitulated. From the results obtained it is concluded that the head of an earth-worm is composed of eight segments, occasionally of nine, but more often of a smaller number, especially when the animal is cut into relatively small parts. When the new head does not contain the normal number of head-segments, the mouth-parts always serve their purposes. If a worm be cut in pieces, each containing eight or nine segments, each piece is tolerably sure to become a perfect worm. When a worm was cut into fourteen pieces, one died, but the rest reproduced both head and tail.——Dr. v. Linstow (*Archiv. für Naturg. 1883*) describes the Nematodes, Trematodes, and Acanthocephali gathered in Turkestan by Professor Fedtschenko. The number of Nematode species (76) is large, compared with that of the Trematoda (15), and of the Acanthocephali (3), but this is accounted for by the fact that the larvæ of the two latter families live in aquatic invertebrates, which are scarce in the unwatered plateau of Turkestan. Eighteen new species of parasitic nematodes are described, including an Ascaris of the sturgeon, one of *Silurus glanis*, and one of *Pastor roseus;* a Physaloptera of *Tropidonotus hydrus;* a Filaria of *Phalacrocorux carbo*, and one of *Turdus atrogularis; Aprocta cylindrica* from *Petræca cyanea; Heterakis curvata* from *Perdix græca; Oxyuris inflata* from *Pterocles arenaria*, and *O. lanceolata* from certain insects. All the species of Gordius and Mermis (8) appear to be new. Of the Acanthocephali two species of Echinorhynchus, from *Petræca cyanea* and *Astur palumbarius*, respectively, are new, as are six forms of Distomum and one of Monostomum among the trematodes.

Amphibians and Reptiles.—M. P. Albrecht notes the presence of true ossified epiphyses upon the spinous processes of many of the vertebræ of *Hatteria punctata*, strikingly resembling the same epiphyses in mammals. The skeleton examined (an adult) had, besides the pro-atlas, 8 cervical, 17 dorso-lumbar, 2 sacral, and 15 caudal vertebræ. The extremity of the tail was in neogenesis. A pair of these epiphyses occur on the 7th and 8th cervicals, and on the dorso-lumbars from the 2d to the 10th, inclusive, and on the 14th and 15th of that series. The remaining two dorso-lumbars, the sacrals, and the first four caudals have a single epiphysis evidently formed by the union of the right and left elements. The epiphyses increase in size to the 16th dorso-lumbar, and thence diminish.——D. J. v. Bedriaga (*Archiv. für Naturg., 1883*), gives descriptions of the Amphibia and Reptilia of Corsica, which he states to be zoölogically almost an unknown

land. He also devotes a large space to the external and internal characters, variations, and development of *Megapterna montana* Savi, and a list of its numerous synonyms, which include the generic names of Triton, Molge, and Euproctus. He believes that the genus Triton should be held to include not only Triton proper, but also Hemitriton, Pelonectes and perhaps Euproctus and Megapterna. Other Corsican amphibia are *Salamandra maculosa*, *Hyla viridis*, *Discoglossus pictus*, *Rana esculenta* sub sp. *viridis*, and *Bufo variabilis*. Our author distinguishes two species of Euproctus, *E. rusconii*, found in Sardinia, and *E. pyrenäica*, a native of Spain, Portugal, and the Pyrenees. The Reptilia of Corsica are *Tropidonotus natrix*, *Zamenis gemonensis*, *Platydactylus mauritanicus*, *Notopholis fitzingeri*; *Lacerta oxycephala*, *L. muralis*, and *L. viridis*, *Vipera aspis*, *Emys orbicularis*, and *Testudo græca*.

Birds.—Among the more valuable articles in *The Auk*, for January, are Mr. Brewster's notes on the summer birds of Berkshire county, Mass.; Mr. N. S. Goss' notes on the breeding habits of the American eared grebes; and Mr. Bicknell begins an interesting study of the singing of our birds, to be continued in the next number. After speaking of the connection between molting and the songs of birds, and of song as the result of mental excitement, of singing while on the wing, the author treats of seasonal variation in song; vocal variation with age; individual vocal variation and abnormal vocal variation.——From the "general notes" we glean the following items: Mr. Montague Chamberlain saw two crows successively charge upon a robin's nest and each fly away with an unfledged robin in its claws. Mr. J. W. Fewkes records the observation of several persons near Cashport, who declared that the crows take up in their claws sea-urchins and carry them up away from shore. "One intelligent person, not a naturalist, said he had observed the crows *transporting them in their claws*."——The nesting habits and eggs of the ruby-crowned kinglet; of *Myiodestes townsendi*; of the saw-whet owl; of the broad-winged hawk; and a newly discovered breeding place of Leach's petrel in Rona, one of the Hebrides, are described. The black-throated auk, a North Pacific sea-bird, is recorded as occurring in Wisconsin.

Mammals.—The beautiful chromo plates illustrating the first volume of the mammals of Brehm's Thierleben, are well worthy of examination, and the publication of these superb colored plates will confer a new value on what is a standard popular work. The plates illustrating the lion, tiger, leopard, puma, but more especially the orang, chimpanzee and the gorilla, are as successful as any. These plates can be had of B. Resteimann & Co., New York.

PHYSIOLOGY.[1]

Localization of Function in the Brain.—The question at present of most fundamental interest in the physiology of the brain is, whether the various functions of the mind are delegated to special nervous centers of the cerebral cortex; in other words, is or is there not, localization of function in the brain. It is admitted by all physiologists that ordinary involuntary actions, like those of respiration, deglutition, &c., are aroused by impulses proceeding from pretty definitely localized nervous centers; but it has been a question of serious dispute as to whether psychical functions are likewise anatomically distributed over the nerve-cell—containing cortex of the cerebrum. Dr. Ferrier, of London, and Professor Goltz, of Strassburg, have been the chief exponents of the two extreme views on the subject. The former, in accordance with the results of numerous experiments upon monkeys, has mapped out the surface of the brain into numerous areas, each of which was supposed to be the seat of origin of voluntary motor impulses for a definite group of muscles, or, it might be, the place where certain special sensations were elaborated. Extirpation of that area would annihilate that function, and stimulation of it would call the function into play. The principal objection to Ferrier's experiments, that his animals were not allowed to live long enough after the operation to give fair chance of recovery from the effects of the shock, has been set aside in the case to be considered, that of a monkey which was killed and submitted to post-mortem examination after having lived in health for seven months succeeding an operation on the left side of the brain. Professor Goltz, working on dogs, has come to widely different conclusions from those of Dr. Ferrier. Goltz finds, in general, that destruction of any part of the cerebral cortex would cause the same paralysis or loss of sensation as that of any other part, in cases where the effect was positive. If the lesion were not too extensive, perfect recovery was gradually attained. But by destroying more and more of the cortex on both sides of the brain, partial paralysis of voluntary motion and loss of sensibility were diffused further over the body and became intensified, and, to some extent, permanent. At the same time the purely psychical powers lost their acuteness until, when nearly the whole of the cerebral cortex was removed, the result was almost total annihilation of the powers of judgment and perception. According to Goltz, the sole function of the cerebrum is to serve as the seat of the purely psychical powers, and any loss of sensation or of motion, which may result from injury to it, are the indirect effects of enfeebled perception. Goltz attributes the definite paralyses and losses of sensation, obtained by Ferrier, to direct inhibition of these functions due to inhibitory influences proceeding from the injured parts.

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

At the meeting of the International Medical Congress, held in London, in 1881, Goltz exhibited a dog, and Drs. Ferrier and Yeo a monkey, both of which animals had months previously been subjected to cerebral operations, and had long been in complete health. After a study of animals by members of the Congress, a committee was appointed, consisting of Mr. Langley, Dr. Klein, and Professor Schäfer, to make anatomical and microscopical examinations of the two brains. The committee has recently presented an exhaustive report on the subject submitted to it.

The dog, when still alive, when let loose in a room, wandered with wagging tail, hither and thither, carefully avoiding obstacles and using his muscles in a perfectly normal manner, with the exception of an occasional slipping of the feet upon the floor, and rather general clumsiness of movement. It was clear that the animal possessed the senses of hearing, sight and touch; but the perceptions usually aroused by these sensations were absent. Thus threatening with the voice or a whip produced no sign of fear. A lighted candle brought suddenly close to the dog's eye was noticed only by an indifferent blink. A patch of sunshine or some bright substance on the floor was carefully avoided as if it had been a solid object.

To use now the words of the report: "Professor Ferrier, London, called attention to the condition of the monkey which he had alluded to in his remarks at the morning meeting; the motor area of the left hemisphere had been extensively destroyed seven months previously. The animal was in every other respect sound, except as to the movements of the right arm and leg. The condition of these was recognized as bearing the closest resemblance to hemiplegia of some duration in man—M. Charcot remarking: 'it is a patient'! The movements of the leg were seen to be greatly impaired, and the arm quite powerless, being maintained flexed at the elbow, the thumb bent on the palm, and the fingers semi-flexed. The animal took pieces of food offered it with its left hand, and neither in its struggles to get free, nor on any occasion whatever, did it show any volitional action with its right hand or arm." One of the chief difficulties in the way of the committee which made the post-mortem examination of the two brains, was to determine the homologies of the various parts of the organs. This could not be done with certainty. The destruction of the dog's cerebrum was somewhat more extensive on the right side than on the left. There appears to have been complete and deeply extended destruction of about three-fourths of the substance of the cerebrum; the parts of the cortex remaining intact included the anterior fourth, the superior and inferior median-lateral portions. Most of the so-called "motor" areas appear to have been included in the lesion.

In the monkey it was found that the greater part of the two central convolutions, together with adjacent parts of the frontal

and parietal lobes, had been removed on the left side of the brain. Secondary disturbances in the body of the organ had probably made the lesion physiologically more extensive than appeared from the surface. The pyramidal tract of fibers in the spinal cord, which is in connection with the cerebrum, was found to be degenerated throughout its whole extent.

To a disinterested person it seems, from the evidence here offered, that Goltz has shown conclusively the absence of localization of function, as that term is commonly understood, for the brain of the dog, while Ferrier has failed to completely establish his theory of localization of function for the brain of the monkey. —*Jour. of Physiology, Vol.* IV, *Nos. 4 and 5.*

Writing with the Voice.—At a meeting of the College of Physicians, last week, Professor Harrison Allen, of Philadelpha, showed a new and very interesting discovery by which spoken language can be represented by a series of curved lines on a receiving surface composed of white paper coated with soot (Ludwig's lymographion). The experiments, which were originated by Professor Allen, from observations which he had made through watching the movements of the soft palate when conducting experiments connected with the human throat, are made with an instrument designed by the professor, and which is very simple and easy of operating. By means of his device he is enabled to register upon the surface of the sooted paper the lines and curves that represent the various phonetic sounds of the human voice. His observations have proved that the discovery will undoubtedly be of great importance in diagnosticating cases of diseases of the palate, and in studying the causes of stammering.

Professor Allen has already shown, by means of his interesting experiments, that many of the sounds which have long been considered by elocutionists to be formed by the direct action of the lips, the teeth, or the tongue, are in reality formed primarily by the action of the palate. The subject is sure to prove one of much importance to the world of science, and the professor thinks it will develop some most interesting facts. Dr. Allen calls his instrument the palate-myograph.

PSYCHOLOGY.

Gregarious and Slavish Instincts.—In his very readable "Inquiries into Human Faculty and its Development," Mr. Galton discusses what he regards as a curious and apparently anomalous group of base moral instincts and intellectual deficiencies that are innate rather than acquired. His method is to trace their analogies among the brutes, and to examine the conditions through which they have been evolved. His argument is, that gregarious brute animals possess a marked want of self-reliance,

that the conditions of the lives of these animals have made a want of self-reliance a necessity to them, and that by the law of natural selection the gregarious instincts and their accompanying slavish aptitudes have gradually become evolved. He then argues that our remote ancestors lived under parallel conditions, and that we have inherited the gregarious instincts and slavish aptitudes which have been needed under past circumstances, but which in our present advancing civilization are becoming of more harm than good to our race.

Reference is then made to the camel, whose urgent need "for the close companionship of his fellows was a never-exhausted topic of curious admiration to me during tedious days of travel across many North African deserts. I also happened to hear and read a great deal about the still more marked gregarious instincts of the llama, but the social animal into whose psychology I am conscious of having penetrated most thoroughly, is the ox of the wild parts of Western South Africa."

These oxen belonged to the Damaras, and none of the ancestry of these cattle had ever been broken to harness. Nearly a hundred of these beasts were broken in dragging the wagon, packs and saddle, and on one of them Mr. Galton rode. After such an intimate acquaintance with and study of these cattle, he writes: "The better I understand them, the more complex and worthy of study did their minds appear to be. But I am now concerned only with their blind gregarious instincts, which are conspicuously distinct from the ordinary social desires. In the latter they are deficient; they are not amiable to one another, but show, on the whole, more expressions of spite and disgust than of forbearance or fondness. The ox cannot endure even a momentary separation from his herd. If he is separated from it by stratagem or force, he exhibits every sign of mental agony; he strives with all his might to get back again, and when he succeeds he plunges into its middle to bathe his whole body with the comfort of closest companionship."

It was found very difficult to procure animals capable of acting the part of fore-oxen to the team, "The ordinary members of the wild herd being wholly unfitted by nature to move in so prominent and isolated a position, even though, as is the custom, a boy is always in front to persuade or pull them onwards. Therefore, a good fore-ox is an animal of an exceptionally independent disposition. Men who break in wild cattle for harness watch assiduously for those who show a self-reliant nature, which is shown by their grazing apart or ahead of the rest, and these they break in for fore-oxen." These wild oxen, Galton concludes, are "essentially slavish, and seek no better lot than to be led by any one of their number who has enough self-reliance to accept that position. No ox ever dares to act contrary to the rest of the herd, but he accepts their common determination as an authority

binding on his conscience." He then goes on to say that "an incapacity of relying on oneself and a faith in others are precisely the conditions that compel brutes to congregate and live in herds; and, again, it is essential to their safety in a country infested by large Carnivora, that they should keep closely together in herds."

An ox feeding alone is easily surprised, yet a crouching lion fears cattle who turns boldly upon him, as they can make ugly wounds with their horns in the paw or chest of a springing beast. Hence, a cow who has calved by the wayside, and is restless and eager for the safety of her calf, even when temporarily abandoned by the caravan, is never seized by lions. Ordinarily, however, when grazing, their heads buried in the grass, or while ruminating, they are peculiarly liable to attack.

Galton's account of a herd of oxen and their relation to their environment is well worth quoting: "But a herd of such animals, when considered as a whole, is always on the alert; at almost every moment some eyes, ears and noses will command all approaches, and the start or cry of alarm of a single beast is a signal to all his companions. To live gregariously is to become a fiber in a vast sentient web overspreading many acres; it is to become the possessor of faculties always awake, of eyes that see in all directions, of ears and nostrils that explore a broad belt of air; it is to become the occupier of every bit of vantage ground whence the approach of a wild beast might be overlooked. The protective senses of each individual who choses to live in companionship are multiplied by a large factor, and he thereby receives a maximum of security at a minimum cost of restlessness."

Natural selection tends to give but one leader to each suitably-sized herd, and to repress superabundant leaders. Moreover, there is "a certain size of herd most suitable to the geographical and other conditions of the country; it must not be too large, or the scattered puddles, which form their only watering places for a great part of the year, would not suffice, and there are similar drawbacks in respect to pasture. It must not be too small, or it would be comparatively insecure," as a troop of five animals are more easily approached by a lion or hunter than a larger one.

The leaders of the herd are safer than those self-reliant animals which graze apart; it is precisely these which are seized by lions. "The leaders are safe enough from lions, because their flanks and rear are guarded by their followers; but each of those who graze apart, and who represent the superabundant supply of self-reliant animals, have one flank and the rear exposed, and it is precisely these whom the lions take. Looking at the matter in a broad way, we may justly assert that the wild beasts trim and prune every herd into compactness, and tend to reduce it into a closely-united body with a single well protected leader. That the development of independence of character in cattle is thus suppressed below its

otherwise natural standard by the influence of wild beasts, is shown by the greater display of self-reliance among cattle whose ancestry for some generations have not been exposed to such danger."

What is said of cattle applies also to savages and barbarians. The inhabitants of the same country as the oxen described, are congregated into multitudes of tribes, all more or less at war with one another. "We shall find that few of these tribes are very small, and few very large, and that it is precisely those that are exceptionally large or small whose condition is the least stable. A very small tribe is seen to be overthrown, slaughtered, or driven into slavery by its more powerful neighbor. A very large tribe falls to pieces through its own unwieldiness, because, by the nature of things, it must be either deficient in centralization or straitened in force, or both." Reference is also made to the extraordinary power of tyranny invested in the chiefs of tribes and nations of men, which leads to slavishness on the part of the subjects. "The tyrannies under which men have lived, whether under rude, barbarian chiefs, under the great despotisms of half-civilized Oriental countries, or under some of the more polished but little less severe governments of modern days, must have had a frightful influence in eliminating independence of character from the human race."

"Our present natural disposition make it impossible for us to attain the ideal standard of a nation of men, all judging soberly for themselves, and, therefore, the slavishness of the mass of our countrymen, in morals and intellect, must be an admitted fact in all schemes of regenerative policy. The hereditary taint due to the primeval barbarism of our race, and maintained by later influences, will have to be bred out of it before our descendants can rise to the position of free members of an intelligent society; and I may add that the most likely nest at the present time for self-reliant natures will be found in States founded and maintained by emigrants."

Teaching Animals to Converse.—Commenting in *Nature* on Miss Martineau's remark, that considering how long we have lived in close association with animals, it is astonishing how little we know about them, and especially about their mental condition, Sir John Lubbock goes on to say, that he believes that it arises very much from the fact, "that hitherto we have tried to teach animals, rather than to learn from them, to convey our ideas to them, rather than to devise any language, or code of signals, by means of which they might communicate theirs to us. No doubt the former process is interesting and instructive, but it does not carry us very far. Under the circumstances, it has occurred to me, whether some such system as that followed with deaf mutes, especially by Dr. Horn with Laura Bridgman, might not prove very instructive if adapted to the case of dogs.

"Accordingly, I prepared some pieces of stout card board, and printed on each, in legible letters, a word such as 'Food,' 'Bone,' 'Out,' &c. The head master of one of the deaf and dumb schools kindly agreed to assist me. We each began with a terrier puppy, but neither of us obtained any satisfactory results. My dog, indeed, was lost before I had had him long. I then began training a black poodle, 'Van' by name, kindly given me by my friend, Mr. Nickalls. I commenced by giving the dog food in a saucer, over which I laid the card on which was the word 'Food,' placing also by the side an empty saucer, covered by a plain card. 'Van' soon learned to distinguish between the two, and the next stage was to teach him to bring me the card; this he now does, and hands it to me quite prettily, and I then give him a bone, or a little food, or take him out, according to the card brought. He still brings sometimes a plain card, in which case I point out his error, and he then takes it back and changes it. This, however, does not often happen. Yesterday morning, for instance, 'Van' brought in the card, with 'Food' on it, nine times in succession, selecting it from among other plain cards, though I changed the relative position every time.

"No one who sees him can doubt that he understands the act of bringing the card with the word 'Food' on it as a request for something to eat, and that he distinguishes between it and the plain card. I also believe that he distinguishes, for instance, between the card with the word 'Food' on it and the card with 'Out' on it.

"This, then, seems to open up a method, which may be carried much further, for it is obvious that the cards may be multiplied, and the dog thus enabled to communicate freely with us. I have as yet, I know, made only a very small beginning, and hope to carry the experiment much further, but my object in sending this communication is two-fold. In the first place, I trust that some of the readers of *Nature* may be able and willing to suggest extension and improvement of the idea. Secondly, my spare time is small and liable to many interruptions; animals also, we know, differ greatly from one another. Now, many of your readers have favorite dogs, and I would express a hope that some of them may be disposed to study them in the manner indicated.

"The observations, even though negative, would be interesting; but I confess, I hope that some positive results might follow, which would enable us to obtain a more correct insight into the minds of animals than we have yet acquired."

ANTHROPOLOGY.[1]

THE GRAND TRAVERSE REGION.—Dr. M. L. Leach commenced a series of contributions to the *Grand Traverse Herald*, Michigan.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

on the 6th of December, having for their subject a history of that particular region. In the first few chapters the Aborigines occupy the prominent place. "Characteristic earthworks are found in Ogemaw county. Mounds are known to exist in Manistee county. Around Boardman lake, near Traverse City, several small mounds formerly existed. Sites of ateliers are frequently discovered, as well as fragments of pottery. The Ottowas were the occupants of this region when it was first visited by the whites. Emmet county was the home of a small tribe called the Mush-quah-tas. They were of Algonquin stock and were a peacable agricultural tribe. Unfortunately they got into a war with the Ottowas, by whom they were pursued and exterminated without mercy. Dr. Leach reviews at some length the connection of the Jesuits with the savages of this country, especially Father Marquette, and shows the connection of the Ottowas with the conspiracy of Pontiac. Of their military operations subsequently there is little material for solid information. In the 4th chapter the author discusses the social life of the Ottowas. He draws attention to a very important fact, that while in the French and Indian wars these Indians invariably sided with the French, they, in 1812, took sides with the English against us, and exhausted their ingenuity in devising the most shocking barbarities. Again, the adoption of only the bane without the blessing of civilization has made their condition worse rather than better. The houses and industries of the Indians are also described in this chapter. In conclusion we have two words to say respecting these letters. The conception is excellent. Every county should have its historian, and he should not neglect the aboriginal record. Again, this work had better not be undertaken, than to de done imperfectly. There may not be any more to be said about the Indians of Grand Traverse, but Dr. Leach has given us a record all too short.

THE FOLK-LORE OF SHAKESPEARE.—President Welling once wrote to a friend, in vacation, "I have spent my time mostly in reading history and novels, but which is history and which is romance I am at a loss to determine." The works of Shakespeare are plays, and would come under the class of romances; but he has read the great dramatist's writings only superficially who has not discovered on every page the most precious information respecting the life-history of his age. In carefully studying the plays of Shakespeare, in order to gather their folk-lore, Mr. T. F. Thistleton Dyer has performed a task which must have been exceedingly pleasant to himself, and which certainly will form a to permanent contribution to ethnology. We are no less indebted Harper & Brothers for republishing the work in an attractive and cheap edition. As children, we all have wondered how one brain could have originated all the forms that flit before us in these

magic plays. Now, we know that it did no such thing. Shakespeare's fairies, witches, ghosts, and devils were all made for him. How in the world could people have comprehended him, embraced him, loved him, if the atmosphere had been peopled by his wand with unfamiliar creatures. But, when he evolved familiar spirits and gathered around him forms well-known to the vulgar mind, the people bowed down and said: "What manner of man is this whom even our underworld obeys?" The same is true of Shakespeare's love of nature. He was thoroughly scientific. He observed nature; but he also observed how the people looked at nature. In Mr. Dyer's work we are astonished on every page to find references to things which are seen among all the savage tribes of earth, and which had come down to the people of Shakespeare's day as a part of that common legacy of usage, which falls to the lot of all. No man's folk-lore library is complete without this volume.

Eskimo and Indian Pictographs.—Dr. W. J. Hoffman, of the Bureau of Ethnology, has brought his varied talent as artist, physician, and sign-linguist, to bear on the interpretation of the numerous Eskimo pictographs in all our museums. His association with Colonel Mallery in the preparation of his standard work on the sign-language, has rendered Dr. Hoffman not only familiar with signs as generally understood, but he has made good use of his opportunities in learning to converse with the Indian delegations, one after another, when they have been called to Washington. Starting out from the knowledge thus acquired, the author conceives that pictographs on wigwams, blankets, robes, as well as on rocks, wood, and ivory, are synonymous with the gesture-speech of various tribes. He proceeds to illustrate his theory by reading off carved inscriptions from California, Michigan and other red Indian localities, just to test the matter. After that some ten or a dozen elaborate Eskimo carvings are interpreted on the same plan. Nothing is more astonishing than to see a row of men, trees, deer, and huts transformed into "A man came from his settlement to the shaman, and said: 'Should I go a hunting?' The shaman presented the man with some fire, and went to the top of his lodge, where he invoked the spirits presiding over game. After coming down, he told the hunter that he would kill five deer. Sure enough, the hunter went out, and succeeded as the shaman had predicted." The paper of Dr. Hoffman was first published in the second volume of the Transactions of the Anthropological Society of Washington, and has since appeared in pamphlet form, published by Judd & Detweiler, of Washington.

Megalithic Monuments in France.—For many a day it has not been our pleasure to read a more entertaining and exhaustive monograph than that published recently by P. Bézier, in Rennes.

entitled "Inventaire des Monuments Megalithiques du Department d'Ille and Vilaine" [in North-west France]. Published by the Societé Archéologique d'Ille-et-Vilaine, 1883, pp. 280, 29 plates, and 2 maps. The plan of the work is as follows: Dolmens, alignments, cromlechs, polishing stones, *pierres a bassins*, rocking stones, to the number of 425 are located and described minutely. This occupies 241 pages, and is followed by a table in which, by number, these megaliths are defined by communes, cantons, and arrondissements. The 29 plates are devoted to illustrating the most prominent and notable of the monuments. The first map locates, by means of the Mortillet and Chantre symbols, every monument in Sixt and St. Just, and the second map, in a general way, indicates the distribution of these works in the entire department above named.

The Anthropological Society of Lyon.—The first part of Vol. 2 of the Bulletin of this society is at hand. Much of the contents has little interest for us. On page 72 is a short paper on Zulus, illustrated with two plates of arms and utensils. There follows a communication on the *tribulum* among the ancients. A specimen of this implement was on exhibition in the Tunis department at our Centennial Exhibition. It is still in use quite extensively in Northern Africa and Western Asia. On pages 92–107 M. Ernest Chantré describes carefully a necropolis explored by him in Koban (Caucasus). M. Cornivin has for a long time been studying the wormian bones in the face of domestic animals—an abstract is given on page 119.

MICROSCOPY AND HISTOLOGY.[1]

Collodion as a Fixative for Microscopical Sections.—Sections fixed by means of a solution of collodion in clove oil, as recommended by Schällibaum[2], may be colored on the slide. The method is as follows:

The solution which is prepared by dissolving *one part collodion in three or four parts clove oil*, is applied to the slide by means of a fine brush, at the time of using. The sections having been arranged, the slide is warmed for a few minutes (5–10) in the oven of a water-bath, in order to evaporate the clove oil. The sections may next be freed from the imbedding mass, and colored according to desire. If the film of collodion be too thick, cloudiness is likely to arise between the sections. The cloudiness can be removed by the use of a brush, wet with clove oil, after the sections have been anhydrated by absolute alcohol.

[1] Edited by Dr. C. O. Whitman, Mus. Comp. Zool., Cambridge, Mass.

[2] H. Schällibaum, "Ueber ein Verfahren mikroskopische Schnitte auf dem Objectträger zu fixiren und daselbst zu färben." Archiv. f. Mik. Anat. XXII, p. 689, 1883.

Gage[1], who had begun to experiment with collodion before Schällibaum's method was published, recommends that the collodion and clove oil be applied separately:

"A solution of collodion is prepared by adding to 2 grams of gun cotton (that used by photographers is good) 54^{cc} of sulphuric ether and 18^{cc} of 95 p. c. alcohol. After the gun cotton is entirely dissolved, the solution should be filtered through filter paper or absorbent cotton. The slides are coated by pouring the collodion on one end, allowing it to flow quickly over the slide and off the other end into the bottle. The prepared slides should be kept free from dust. As the collodion will not deteriorate after drying on the slide, any number of slides may be prepared at the same time. Before using a slide it should be dusted with a camel's hair brush, and with another brush the collodionized surface of the slide should be thinly painted with clove oil.

" * * * The sections are arranged as in the shellac method. The slide is warmed over an alcohol lamp and then heated in a warm chamber so as to drive off the clove oil. After cooling, it may be placed in a wide-mouthed vial of turpentine, chloroform, xylol, or refined *naphtha*, to remove the paraphine. Naphtha is very cheap, and is the best agent we have yet tried for dissolving the imbedding mass. The sections are usually freed from imbedding mass within half an hour, though the slide may remain in any of the solvents mentioned for two or three days, or perhaps indefinitely, without loosening the sections. When the slide is removed from the naphtha, the sections are washed with 95 p.c. alcohol by means of a medicine-dropper, or by immersing the slide in alcohol. If the sections are to be stained in Kleinenberg's hæmatoxylin or in any other stain containing 50 p.c. or more alcohol the slide is transferred directly from the alcohol used for rinsing to the staining agent, otherwise it should be first transferred to 50 p.c. alcohol and from that to the staining agent. Whenever the sections are sufficiently stained, they may be mounted in any desired mounting medium. In case Canada balsam is to be used, the slide must be immersed in alcohol to wash away the stain, and finally in 95 p.c. alcohol to completely anhydrate the sections. They are cleared with a mixture of carbolic acid 1 part, turpentine 4 parts. The balsam to be used is prepared by mixing 2 grams of pure Canada balsam with 2^{cc} of chloroform and 2^{cc} of clove oil. The latter very soon removes any cloudiness that may have appeared in the collodion film."

Born's Method of Re-constructing Objects from Microscopic Sections.[2]— Dr. G. Born describes in detail a very ingen-

[1] H. Gage and T. Smith. "Serial Microscopical Sections," *The Medical Sciences*, p. 14, November, 1883.

[2] G. Born. "Die Plattenmodellirmethode." Archiv. f. Mik. Anat. XXII., p. 584, 1883. First described in Morphol. Jahrbuch II., p. 578, 1876.

ious method of constructing models of objects from serial sections. By the aid of the camera the outlines of the sections are transferred to wax plates, which are then cut out so as to correspond in outlines as well as dimensions to the sections equally magnified in all three directions. With plates thus prepared, it is only necessary to put them together in the proper order to obtain a complete model. The method is simple and extremely useful, especially in investigating objects with complex internal cavities.

Born has made use of the method in studying different parts of the vertebrate head; Swirski, in elucidating the development of the shoulder-girdle of the pike; Stöhr, in tracing the development of the skull of amphibia and teleostei; and Uskow, in studying the development of the body cavity, the diaphragm, etc.

An illustratian of the method.—Born makes use of three rectangular tin boxes of equal size, each measuring $270^{mm} \times 230^{mm} \times 21\frac{1}{2}^{mm}$. Sections should be made about $\frac{1}{25}^{mm}$ thick (never thinner than $\frac{1}{50}^{mm}$). If we desire to construct a model of an object from serial sections $\frac{1}{30}^{mm}$ thick, which shall be magnified 60 diameters, then the wax plates must be made 60 times as thick as the sections, *i.e.*, 2^{mm} thick.

The surface of a plate that could be made in a box of the above named dimensions, contains $62{,}100\square^{mm}$; and the volume of such a plate 2^{mm} thick would therefore be 124.2^{ccm}. The specific gravity of common raw beeswax amounts to .96–.97. For use, it requires only to be melted and a little turpentine added to make it more flexible. Thus prepared, its specific gravity is about .95; and this number has been found sufficiently accurate in all cases. The weight of the wax required to make one plate of the above size, will accordingly be 117.99 gr., or, in round numbers 118 gr. The wax having been weighed and melted, the tin box is first filled $1\frac{1}{2}^{cm}$ deep with boiling water, and then the melted wax poured upon the water. If the water and the wax are quite hot, the wax will generally spread evenly over the surface; if gaps remain, they can be filled out by the aid of a glass slide drawn over the wax. As soon as the plate has stiffened, and while it is still soft, it is well to cut it free from the walls of the tin box, as further cooling of the water and the box might cause it to split. By the time the water becomes tepid, the plate can be removed from the water to some flat support, and left till completely stiffened. Half a hundred plates may thus be prepared in the course of a few hours.

The outlines of the section are transferred to the plate in the following manner: A piece of blue paper is placed on the plate with the blue side turned toward the wax, and above this is placed a sheet of ordinary drawing paper. The outlines are drawn on the latter by the aid of a camera, and at the same time blue outlines are traced on the wax plate. The plate can then be laid on soft

wood and cut out by the aid of a small knife. Thus a drawing and a model of each section are prepared. The plates thus prepared can be put together in the proper order, and fastened by the aid of a hot spatula applied to the edges.

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SCIENTIFIC NEWS.

—A Scientific Swindler.—A few weeks ago, a man calling himself W. R. Taggart, and claiming to be a member of the Ohio Geological Survey, visited Philadelphia. He called on the principal scientific men of this city, and attended one of the regular meetings of the Academy of Natural Sciences. He seemed to have an extended acquaintance with scientific men, talked very glibly about fossils, and claimed to be writing a report on the Productidæ. He is about 5 feet 8 inches in height, weight, 160 pounds, heavy set, heavy featured, light hair, rather deep set eyes, rather shabbily dressed. He had an adroit way of ingratiating himself into the confidence of his intended victims, and then if he could not steal, he would, under some plausible pretext, borrow valuable books or specimens to take to his hotel and forget to return them. His victims are to be found in nearly every important town in the country. In New York, he was E. D. Strong, of Fort Scott, Kansas, and was employed by the Kansas Pacific railway to collect statistics of coal production. In West Philadelphia he gave his name as E. Douglas, of Columbus, Ohio, member of the State Survey. In Auburn, N. Y., he was a deaf mute under the name of E. D. Whitney, U. S. Geologist, Denver, Col. There he obtained a large quantity of valuable geological books and fossils from Professor Starr. In Harrisburg, Chambersburg, Indianapolis, and Columbus, he was a deaf mute. At Indianapolis he swindled the State Geologist out of $100 worth of rare books, among them Schimper's "Palæontologie Vegetale." He has been permitted access to several museums, public and private, from which he has abstracted valuable specimens and sold them. Any information in regard to the real name and residence of this man is much desired.

P. S.—I hear from Professor Lesquereux that he was at Columbus, that he has swindled some parties at Dayton, O. He got hold of valuable Indian relics from the Cleveland Historical Society worth $50 or more. From Professor Mees, of Athens, O., he borrowed some valuable physical instruments and sold them, &c., &c.—*F. V. H.*

— We reprint with pleasure the following appreciative notice of the late Mr. Robert B. Tolles, optician, of Boston, which appears in the *English Mechanic:* During several years past he devoted himself to the improvement of the microscope, and to the production of telescopes of unusually short focus, and his work

was characterized by great originality and excellence. He was one of the first opticians in America to construct object-glasses for the microscope on Amici's immersion system, and he succeeded in developing several original formulæ by which he extended the apertures far beyond the limit previously attained in either Europe or America. One of the earliest examples of his work seen in this country was a one-sixth water-immersion object-glass, now in the possession of Mr. Frank Crisp, Secretary of the Royal Microscopical Society, and which was the subject of much discussion in journals devoted to microscopy. Mr. Tolles claimed for this object-glass an aperture which was generally regarded as impossibly large. After much controversy he had the satisfaction of receiving the support of Professor G. G Stokes, Secretary of the Royal Society, Professor S. Newcomb, Director of the Washington Observatory, and Professor E. Abbe, of Jena University, for the general accuracy of his views. He was an enthusiast in his work, and was almost incessantly engaged in making experimental object-glasses both for the microscope and telescope, many of which exhibited rare qualities, and were eagerly sought for by amateurs of fine work. He made the highest power microscope object-glass produced in America, a water-immersion of $\frac{1}{75}$in. in focal length. One of his latest and most successful telescopes was a $5\frac{1}{2}$in. portable equatorial of very short focus for Professor Hamilton L. Smith, of Hobart College, who has published his trials of the instrument, proving it to be of exceptionally fine quality. The numerous improvements devised by Mr. Tolles in the construction of the microscope have done much to place American optical workmanship on a par with the best in Europe.

— In the March number of the AMERICAN NATURALIST, Mr. Titian R. Peale repeats the old account of the Bowditch islanders being ignorant of fire at the time of their discovery in 1841. While Mr. Peale has the advantage of being an eye witness of what he describes, I would call attention to the fact that the story is discredited by ethnologists, and notably by Tylor. It would seem that the members of the Wilkes' expedition had misinterpreted the expressions of astonishment, for Hale, the ethnologist of the same expedition, gives the native word for fire, while the Rev. Mr. Turner, who visited the island a few years later, gives evidence that they had been acquainted with fire for so long a time that the origin of their knowledge had passed into a myth.—*F. S. Kingsley.*

— At a meeting to which the entomologists of Washington and Baltimore were invited, held at the house of Dr. C. V. Riley, in Washington, D. C., on the evening of 29 February, 1884, and presided over by Rev. Dr. John G. Morris, of Baltimore, a resolution was adopted unanimously to establish an entomological society in Washington and vicinity, and a committee was ap-

pointed to draw up the necessary regulations, and to call a future meeting for organization.—*B. Pickman Mann, Secretary.*

— The death of Dr. Hermann Schlegel, director of the Zoölogical Museum of the University of Leyden, is announced. He was born in Saxony. Under his direction the Leyden Museum became one of the most important in Europe, and its collection of skeletons is one of the finest known. It is especially rich in the forms of the Dutch Malaysian colonies. Dr. Schlegel published a number of zoölogical works, among the most important of which are the catalogues of the museum. He was distinguished for his carefulness, and for his extreme conservatism in questions of nomenclature.

— During the past season was founded in Providence the Rhode Island Entomological Society, with Mr. Calder as president, and F. E. Gray, secretary. The society holds monthly meetings.

— Mr. J. L. Wortman has been appointed anatomist of the Army Medical Museum at Washington.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Feb. 23.—Communications were presented by Elliott Coues on the present state of North American ornithology; by Charles D. Walcott entitled, Further remarks on a rock specimen from Maine, containing corals (with specimen); by Marshall McDonald on natural causes influencing the movements of fish in rivers; and by Lester F. Ward on the diamond willow (with specimen).

New York Academy of Sciences, Feb. 4.—The following paper was presented: The botany, geology and resources of the country traversed by the Northern Pacific railroad (illustrated with lantern), by John S. Newberry.

Feb. 11.—The following papers were read: Theories in regard to the causes of the recent red skies, by John K. Rees; A memorial notice will be read by the secretary of the late vice-president of the academy, Dr. Benjamin N. Martin.

Boston Society of Natural History, Feb. 6.—Mr. T. T. Bouvé read a paper on the genesis of the Boston basin and its rock formations; and Professor N. S. Shaler discussed the origin of kames.

Feb. 20.—Dr. T. Sterry Hunt spoke of the Cambrian rocks of North America; and the president described the fossil larvæ from the Triassic rocks of the Connecticut valley.

American Geographical Society, Feb. 18.— Mr. Albert G. Browne, Jr., delivered a lecture entitled, The growing power of chile, in the Pacific (illustrated with views).

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THE MEZQUIT.[1]

BY DR. V. HAVARD, U. S. A.

Name.—This tree, the most notable feature of our Southwestern sylva, belongs to the large order of Leguminosæ, suborder Mimoseæ. It was first described by De Candolle under the name of *Prosopis juliflora*, which, therefore, has precedence. Prosopis, as applied by Linnæus, is meaningless; the specific name (julus, a catkin) refers to the catkin-like spikes of the inflorescence. It is the *Algarobia glandulosa* of Torrey and Gray's Flora (from Algaroba, Mexican synonym of mezquit, the specific name referring to the stalked glands borne on the anthers), later changed into *Prosopis glandulosa* by Dr. Torrey, in the Flora of the Mexican Boundary Survey.

Habitat.—The mezquit finds a congenial home through Mexico, and extends to Chili and Brazil in South America. It flourishes on the southwestern territory of the United States, specially in Texas, New Mexico, and Arizona, being by far the most common tree or shrub of the immense desert tracts drained by the Rio Grande, Gila, and Lower Colorado. It does not grow near the seashore, except at the mouth of the Rio Grande. If, from this point, we proceed northward, we find that the mezquit disappears from the coast and recedes inland twenty or thirty miles, remaining at about that distance from the sea up to Victoria and Columbus; thence the line of its eastern limit runs directly north, passing a few miles out of Dallas; bending slightly westward, it then

[1] This name, often misspelt and mispronounced, is, in its Mexican form, mezquite, with the accent on the penult, and the last syllable obscurely sounded. North of the Rio Grande, in its Americanized form, it drops the final e, but otherwise retains the Mexican accent and pronunciation, thus, mezkeet'.

crosses the Red river, and, entering the Indian Territory, passes north of Fort Sill, crosses the Canadian, and strikes the 37th parallel where the 100th meridian intersects it. Near this point Mezquit creek, from Kansas, empties into Cimarron river. The northern limit may be said, practically, to be the 37th parallel: that is, the southern boundary of Colorado and Utah. It takes in the southern point of Nevada, the large desert tracks of South-eastern California, and, at its extremity, bends down towards Fort Tejon. The western limit is the rather uncertain line made by the western margin of the Mojave and Colorado deserts, nowhere, as far as I know, coming close to the shore of the Pacific.

Description.—Shrub, or tree, with thorny branches and deciduous foliage.

Bipinnate leaves, single or in clusters, mostly armed with a pair of stout, straight, whitish thorns. One, seldom two, pairs of pinnæ; these 3–6 inches long, bearing 8–15 pairs of leaflets, which are linear-oblong, rigid, 1–2 inches long, and 1½–3 lines wide, varying much in size according to soil and stage of growth. Petiole 2–4 inches long, minutely stipulate, bearing at its apex a cup-shaped gland and filiform appendage.

Flowers 5-parted, a line or more long, on short but distinct pedicels; in axillary, short-peduncled, cylindrical spikes, 1½–4 inches long; greenish-white at first, later more conspicuously yellow from the exserted stamens; very frequent. Calyx smooth, short, hardly half as long as the corolla, with short, acute teeth. Petals valvate, narrowly long, free, greenish or yellowish-white, smooth outside, woolly within and at the apex. Stamens 10, free, exsert, straight and diverging, at least twice as long as the corolla, with versatile anthers; the large, blackish connective mostly bearing at its apex a stalked gland. Ovary shortly stipitate, woolly; style with small terminal stigma as long as the stamens.

Ripe pods white yellowish, mottled with red; 4–8 inches long, 10-20 seeded; from 2 to 12, seldom more than 5 or 6 on the same peduncle; linear, compressed, falcate, constricted between the seeds, indehiscent. Exocarp ligneous and tough; mesocarp thickish and spongy; endocarp papyraceous, inclosing the seeds in separate, flat casings, quadrate from natural pressure, and placed obliquely in the pod of which they occupy nearly the whole breadth.

Seed oval, smooth, suspended from the apex of the apparent

cell by a long, coiled funiculus, with ascending radicle and plane, foliaceous cotyledons.

Size and Shape.—In size the mezquit ranges from an inconspicuous bush to a middle-sized tree. On high plains, alkali flats, or stony bluffs, it is a gnarled, stunted shrub, while on rich bottom-land it becomes a tree forty feet high, with an undivided trunk 2 feet in diameter, and from 7 to 10 feet long. Most of the arborescent mezquit, however, is only 6–12 inches thick; and shrubby mezquit, of all proportions, preponderates over the arboreal. The largest trees I have seen are in Southeastern California and Southeastern Texas.

The trunk usually divides a short distance above ground, and gives off crooked branches at various angles and heights, so that most trees have a loose, straggling, unsymmetrical shape. Under very favorable circumstances the mezquit becomes even-spreading and round-headed, bearing at a distance some resemblance to the apple-tree.

Foliage.—The mezquit, naked and repulsive in winter, begins, early in March, to clothe itself with verdure, giving life and freshness to the dreary slopes and bottom-lands. Its early foliage is of the most delicate emerald-green, which gradually deepens without ever reaching a somber hue. The scattered leaflets, thin and rigid, sift the sunlight, and only throw on the ground a speckled and illusory shadow, in which one vainly seeks protection from the heat. This thinness of foliage, apparently intended to prevent excessive loss of moisture, would prepare one to expect comparatively few stomata on the surface of the leaves, they being the open mouths through which aqueous exhalation takes place; but the fact is, that they are numerous, indeed far exceeding in number those found on plants growing in more favored climes. Thus the mean of several observations was, for the upper surface, 63,660, and for the under surface 143,235 on the square inch. It may be noted that the leaflets stand in all positions, oftener in a vertical or oblique plane than horizontally, and therefore that the difference between the two sides, almost equally exposed to light, is also remarkable.

Flower and Fruit.—The mezquit begins to blossom about the middle of May, and crops of flowers succeed one another until the middle of July. The pods, or "beans," form early in June, and ripen throughout July and August. In dry places they are

ripe before the end of June, while in other localities they are not yet mature on the first of September.

Roots.—The roots of the mezquit seem, in a great measure, to exist independently of the stems, and may attain large proportions when hardly any foliage is visible above ground. It is probable that when the branches have been destroyed by fire, or stunted by hot, desiccating winds, the sap brought up by the deep rootlets is mostly assimilated by the upper superficial roots, which grow thick and tortuous. Sometimes, in the Southwest, camps are pitched on plains where no timber or fuel of any sort is visible. It is then that the frontiersman, armed with spade and axe, goes "digging for wood." He notices a low mound, on whose summit lie a few dead mezquit twigs; within it he finds large, creeping roots, which afford an ample supply of excellent fuel. These roots can be pulled out in pieces fifteen to twenty feet long, with a yoke of oxen, as practiced by the natives in the sandy deserts of New Mexico and Arizona, where no other fuel can be had.

Mezquit roots are of two kinds. Some dip vertically into the ground, solely in quest of food; others spread laterally, often many yards, before sinking inwards, their object apparently being to extend the area of supply and steady the plant. These horizontal roots, radiating in all directions, form a loose netting in the subsoil, helping to hold and compact it together. The heaping of the sandy soil around the base of the stems, by the wind, causes secondary roots and branches to start, which entrap and retain more of the light earth, so that presently each tree or shrub appears as if growing from a mound. Of the vertical roots, the taproot is often the only large and conspicuous one. It plunges down to a prodigious depth, varying with that at which moisture is obtainable. On the sides of gulches one can trace these roots down thirty or forty feet. They branch off and decrease in size if water is near by; otherwise they, even at that depth, retain about the same diameter, giving off but few unimportant filaments. How much farther they sink can only be conjectured. In the valley of the Rio Grande, big mezquit trees grow at an altitude of forty and fifty feet above the river level.

It would seem, then, that the mezquit, at least in the arborescent form, does not depend for the water it requires upon the moisture of the subsoil, but is enabled to extract it from the lower strata, and that its spongioles are bathed in permanent water. This is

useful practical knowledge. Thus, wherever it reaches the proportions of a tree, we may be reasonably sure that water is within forty or fifty feet, and, wherever it grows as a thrifty shrub, within fifty or sixty, whatever may be the character of the surface stratum. The most desolate parts of the Staked plains are the Sand-hills—bare heaps of shifting sand. Between these are sometimes found large, vigorous mezquit shrubs, the only arborescent vegetation there. The inference would be that water, although too deep for the ordinary shrubs of the country, is accessible to the mezquit, and should be reached at a depth of about sixty feet, a conclusion practically verified by the digging of wells along the Texas-Pacific railroad.

When the roots have to dip down to a greater depth than sixty feet, the stems remain dwarf and scrubby.

Climate and Soil—The mezquit is not very sensitive to cold, and frosts, if not below zero, do it no apparent harm. It thrives best, however, in a hot and dry climate; one with mild winter and high summer temperature, small rainfall and clear atmosphere. Such climate is that of the Southwestern States and Territories. Within these there is hardly any soil, if not habitually damp, in which mezquit cannot grow; no hill is too rocky or broken, no flat too sandy or saline, no dune too shifting, no prairie too often burned, to entirely exclude it. It attains its full development on dry, loamy bottom-lands, where the soil is rich and porous, the water not too deep, and the prevalent winds shut off. On the contrary, it dwindles to its minimum size, a mere cluster of twigs, on high grassy slopes and rolling prairies, often visited by fires and always swept by winds.

When once in possession of the soil, it becomes a sort of arborescent weed, of wonderful vitality, and most difficult of eradication. Thus I know of a military post where the bushy growth of mezquit covering the parade was cut close to the ground twice a year; but these successive mutilations only rendered it more vigorous, so that the labor of cutting and pruning increased every year. Again, I remember a good-sized shrub which had tumbled down, with the overhanging edge to which it clung, to the bottom of a ravine; there it lay prostrate, mangled, head under, partly buried, and roots in the air. In its fall the main or top root had been broken; but two vine-like rootlets, ten feet long, issuing from the side of the ravine, still remained connected with it, and,

judging from the unfaded foliage, furnished enough nutriment to sustain life.

Propagation and Growth.—One, viewing the extent and denseness of mezquit woods, and the intricacy of the many creeping, superficial roots, would be likely to suppose that this plant propagates itself by subterranean runners. Such is not the case. Often, indeed, the base of shrubs, or small trees, becoming buried in the loose soil, secondary branches growing off the spreading lower limbs now under ground, may seem to spring from runners, but it is merely so in appearance; mezquit is propagated by seed only.

It seldom happens that the pods, as they drop to the ground, are placed under favorable conditions for germination; they mostly decay on the soil, or are destroyed by insects; so that we may, in the spring, explore extended woods without finding a single yearling sprout. The spontaneous growth of seedlings occurs only in particularly propitious seasons, at irregular intervals of years.

We often see spring seedlings, growing unbidden, in cultivated beds or plots which have been watered and fertilized; likewise around the edges of manure heaps after rains; so that there should be no difficulty, with some care, to raise the plant from the seed at will. The indehiscent pod should be broken into its many one-seeded joints, and these planted at the beginning of the rainy season in well-prepared ground. Next year the young seedling may be a foot or more high, and can be transplanted wherever wanted, during the summer rains. In four or five years it has become a goodly shrub.

Thereafter the growth of the mezquit is very slow. When about thirty years old, the stem is seven or eight inches in diameter; when about seventy-five, from ten to twelve inches; and when the diameter exceeds a foot, the tree is one hundred years or more old.

Generally sprouts grow in clusters, because of the germination of several seeds from the same pod. On rich bottom-land the strongest stem, in time, destroys the others, and alone survives into a tree; on higher and dryer land several of the stems develop simultaneously, forming clusters of thick shoots more or less coalescing at base, a mode of growth common on the hills about San Antonio.

The dissemination of the seed, shut up in the closed pod, is always difficult. There are agencies, however, which may transport pods or seeds at indefinite distances. One is water, rushing with great force through many arroyos towards rivers. To it is due, in part, the fact that most valleys and bottoms are timbered with a large proportion of mezquit. Another is the fæces of horses, mules, cows, and native mammals which feed on the pods; they always contain the undigested pips in good condition for germination.

Uses.—The foliage of the mezquit is practically useless. If at times goats or mules are seen to browse it, one may be sure there is no other food within reach. I have been told that, on the Lower Rio Grande, cows sometimes eat the young leaves in the early spring, and that their milk, in consequence, becomes bitter and unfit to use.

The trunk is ordinarily too short, and often too crooked and knotty, to make it serviceable as timber. Mezquit posts, much used in fencing, are said to be indestructible, whether under or above ground.

I believe this plant is capable of making excellent hedges. Seedlings, as mentioned before, are easily raised, and if transplanted in prepared ground during the rainy season, they should, in three or four years, develop into vigorous shoots, which, by proper pruning and trimming, will form impenetrable hedges.

The wood is very hard, heavy, fine-grained, and takes a beautiful polish. Longitudinal sections are prettily marked with wavy, sinuous veins; the very eccentric rings, although very close, are distinct; the serried medullary rays are hardly visible to the naked eye. The heart-wood is richly colored, its several zones varying from yellowish-red to purple, and contrasts sharply with the pale yellow of the superficial layers. These qualities render mezquit wood valuable for cabinet-work. Unfortunately it too often happens that the zones of the heart-wood are fissured, decayed, or detached from each other, so that it is difficult to get flawless boards.

In San Antonio and Brownsville, Texas, pavement blocks of mezquit are used on several streets, and said to answer the purpose excellently well.

As fuel, the wood, from both root and stem, is unsurpassed. It is the most commonly used from San Antonio, Texas, to San

Diego, California, and often the only kind obtainable. According to Dr. Loew, the charcoal made from this wood is of the best quality for metallurgical and smelting purposes.

During the summer months, from May to September, there exudes from the bark of the mezquit a gum which concretes in tears of variable size, and of a light amber color. It has the taste of gum arabic, makes excellent mucilage, and dissolves readily in three parts of water, the solution having a slight acid reaction. Chemically, it is distinguished from gum arabic in not being affected by subacetate of lead, which, in a solution of the latter, throws down a thick, white precipitate.

This gum is mostly found in old, decrepit trees, with thick, cracked bark, and accumulates in knot holes and around fractures. More rarely is it seen on young, vigorous, and smooth-barked trees. The yield is increased by practicing incisions on the trunk. In these the gum which slowly forms above, under the cambium layers, demonstrates its derivation from the descending sap. It often happens that the exudation fails to concrete, and runs upon the bark in large, black, tarry streaks and patches.

The quantity of gum naturally produced during the season by a large tree is small, probably not exceeding a third of a pound. It is doubtful whether the yield could be increased to a pound by incisions. Therefore this gum, although of prime quality, can hardly ever become an important article of trade.

The fruit of the mezquit contains nutritive principles which make it a valuable article of food. Most herbivorous animals are fond of it, and thrive on it. In the field it is a welcome though imperfect substitute for grain. Horses and mules soon learn to know the tree or bush, always abundantly fructiferous, and as soon as let loose go in search of the fallen pods lying in the grass under the thorny branches. While green, and until thoroughly ripened, the "beans" are bitter and worthless as food. At full maturity they fall to the ground, when they should be at once collected before wetted by rain and stored in a dry place. Under these conditions they keep well until the next crop. When left on the ground they soon deteriorate and decay. They have a particular enemy in a small coleopterous insect which lays its eggs in the seeds, so that in picking up an old pod we shall usually find each joint bored with a hole leading to the corresponding seed.

If we take the dry pod, thoroughly triturate it in a mortar with water, and afterwards strain, we get an aqueous extract containing all of its nutritive elements. The residue, nearly one-half (forty-seven per cent) of the whole pod, consists of shreds of the epicarp, the broken endocarp, and the seeds; it is indigestible, and always voided with the fæces. The aqueous extract, containing fifty-three per cent of the pod, consists of vegetable albumen, gum and grape-sugar, with traces of fat and salts. Its pleasant sweetness to the taste at once reveals the presence of sugar; but, owing to some interfering principle, the usual reagents fail to show even a trace of it. It is only after extraction with alcohol, evaporation, and solution in water that Fehling's test can be successfully applied. A careful analysis yielded twenty-six per cent of glucose. Dr. Loew (Rothrock, Botany W. of the 100th meridian) found thirty per cent.

Thus it is seen that mezquit "beans" differ widely from corn or oats in composition, and therefore cannot produce the same effects on animals. Only about one-half its weight being assimilable, it is a much more bulky food. It is rich in sugar and nitrogen, but deficient in starch, fat and salts. Before the advent of railroads, when grain was scarce in San Antonio, mezquit pods were regularly brought to market and sold for a dollar a bushel.

They constitute a favorite food of Mexicans and Indians. The ripe pod is ground on the "matate," the seeds picked out, and the coarse flour thus obtained is cooked into cakes, or, after seasoning, wrapped in corn-husks like "tomales." Mezquit "atole" is made by throwing the pods into boiling water; when cooked, they are put in fresh water and pounded into a pulp, which is strained; the liquor, containing in suspension and solution all the nutriment of the fruit, is drank ad libitum, and is a very pleasant beverage. Or, again, the pods may be triturated first and the flour boiled afterwards.

The infusion of this flour can easily be made to undergo alcoholic fermentation, whereby a weak beer is obtained, formerly much used by Comanche and Apache Indians.

THE LARVAL THEORY OF THE ORIGIN OF CELLULAR TISSUE.

BY PROFESSOR ALPHEUS HYATT.

AT a meeting of the Boston Society of Natural History, held March 5, Professor Hyatt reviewed the history of investigations upon the structure of the Porifera; concluding that though true Metazoa, they nevertheless still retained characteristics of Protozoa. They possess, in adults, the three typical layers, ectoderm, mesoderm and endoderm, and reproduce by means of true nucleated eggs and spermatozoa developed in the mesoderm. The embryos in the lower forms develop, as observed by him and figured by Barrois in Halisarca, by passing through a hollow morula, as do also several species of the higher forms of Carneospongiæ, having silicious spicules, which are now by most authors supposed to have only a solid morula.

The differentiation of the egg is slightest in forms like Halisarca, and possibly also in Gastrophysema, one of the Calcispongiæ; if Haeckel's figures of these really represent sponges. In the higher forms of both Carneospongiæ and Calcispongiæ, especially the latter, the eggs become differentiated into endoderm and ectoderm at a very early stage of segmentation, and all larval stages are much shortened, in accordance with the law of concentration and acceleration in development. This law is founded upon the fact, now generally established by observation, that the young of descendant types inherit characteristics and tendencies, or habits, at earlier stages than those in which they first originated in their ancestors.[1]

Thus the young of Sycandra is the exact structural parallel of the adult of Leucosolenia, a genus of a lower order, Ascones. It is at first a tube with thin walls as in Leucosolenia, and then develops the characteristics of its own order, Sycones, forming a thick wall, and the cœlomatic cavity branches into radiating tubes, keeping up connection with the exterior through open external pores. The cells in the main cavity of the larva, which are all flagellated and collared, lose their cilia and collars except where the enlargements of the branches occur, forming the ampullæ, the essential characteristic gastric cavities of all sponges with thick mesoderm.

[1] See Evolution of Cephalopods, *Science*, Nos. 52–53, and Genera of Fossil Cephalopods, Proc. Bost. Soc. Nat. Hist., Vol. XXII, p. 262.

The three layers can be exactly compared with the three layers of all the Metazoa, the outer, the ectoderm, is essentially a protective and respiratory layer, the inner, the endoderm, is devoted in Ascones to digestion, or rather consists wholly of feeding zoöns, the central, the mesoderm, is a supporting layer secreting the primitive spicular skeleton, as in Hydrozoa, Actinozoa and all Metazoa. This skeleton, in its spicular character, is similar to the primitive condition of the skeleton in most and perhaps throughout all the Metazoa, the mode of formation being essentially at first spiculous and then solidified through the binding together of the loose elements remotely comparable with the spicules of Porifera. It will be noticed also that in sponges the products of the mesoderm are largely inorganic, as in the skeleton in the Metazoa, and the products of the ectoderm are also horny, as in the Metazoa. The skeleton of Keratosa, the well known webs of elastic threads, which compose the masses known as commercial sponges, are not products of the mesoderm, but really built by the ectoderm.

The process of digestion in Ascones and in the ampullæ is purely protozoönal. The cells capture food, living and in an unprepared condition, from the water coming in through the pores. They must be admitted to have retained both the structure and the habits of the flagellate Protozoa, as has been shown by Clark, Carter and Saville Kent. They are really a distinct branch on the lower borders of the Metazoa, derived from the Protozoa, and equal taxonomically to either Hydrozoa or Actinozoa, forming in fact parallels to the first in their development of the cœlomatic cavity and gastrovascular system, and even uniting, in this respect, the two systems of the Echinodermata, the water and gastric system, into one system with two sets of tubes. They have, in fact, the incurrent or supply system formed by the ectoderm connecting with the cloacal outlet system formed by the endoderm in all the fleshy sponges, Sycones and Leucones.

Every sponge may, however, be morphologically considered, when reduced to its simplest elements, as a sac of collared and flagellated cells surrounded by the mesoderm and inclosed in the ectoderm. This sac has but one opening, an excurrent and incurrent aperture, but this opening is not the blastopore or primitive mouth of the gastrula stage. It occurs by a breaking through at the opposite pole of the body after the attachment of the

larva, which occurs mouth downwards, as shown by Schultze in Sycandra. This primitive opening is also present at an earlier stage in the free larvæ of all the higher forms of Carneospongiæ. Haeckel's parallel between the development of the egg and the evolution of forms among Protozoa, from the unnucleated to the nucleated, seems to be correct, and the morula can be equally closely compared with the colonial free forms of Flagellata like Uvella and Volvox. Recent investigations by Balbiani, Bütschli and Engelmann have removed almost every obstacle, which formerly existed, to the close homology of the single cell among Metazoa with a full-grown adult Protozoön. We can now even closely compare the nuclei of the Protozoa and its changes during conjugation and subsequent casting off of part of the nucleus, to the casting off of polar cells in the egg. The heads of the spermatozoön in the Calcispongiæ have been shown, by Poléjaeff, to arise from division of a part of the nucleus, the other or central part either remaining quiescent or, as this author states, form the tails. Almost every author, especially La Vallette St. George, the most thorough student of this subject, consider all spermatozoa as derived from simple processes of cell division. The essential and general character of reproduction among Protozoa is similar, being, as is well known to observers, fissiparous division of the whole body, but this division takes place in the adults at the end of a series of transformations, and is not characteristic of larval stages. The building up of the tissue in Metazoa is due to the quick and rapid division of cells, and if it is granted that Metazoa may be aggregates of Protozoa, they must be considered, in fact, larval forms descended from Protozoa and inheriting the tendency to reproduction, by fissiparous division, at an early stage. In other words, they reproduce while still larvæ and before passing through any transformations, except the very primitive ones which precede and include the nucleated stage.

We can account for the three layers, by supposing that there must have been among the protozoönal ancestors of the Metazoa transitional forms which were colonial, and in which a part of the feeding zoöns, the collared and flagellated cells, became differentiated into flattened protective zoöns. The next stage would be represented by another form, in which to these two classes of zoöns, a third would be added in the shape of supporting zoöns. We can readily imagine all of these as attached colonies, and

even think of the supporting zoöns, which represent the inclosed mesoderm of Metazoa, as resting on the ground. The inclosure might have been simply due to concentration in the larvæ of descendant forms, which connected them with the Metazoa, since this would be a natural sequence of inheritance with concentration of the secondary formation of the mesoderm. Of course this picture can only indicate what seems to us the probable course of the morphology, and also our disposition to regard as unfounded all hypotheses which have asserted that essential structural characters originate, as a rule, in larval stages, or are likely to occur without being derived through inherited concentration of characteristics from former generations. Simultaneously with the differentiation of supporting or mesodermic zoöns, we should also expect to find male and female zoöns arising, if the results of investigations among sponges mean anything, from among the supporting zoöns, or becoming, at least in the immediate transitional forms, confined to this layer.[1]

It is not of course necessary to this hypothesis that no other transitional forms occurred leading to other types of Metazoa, or that all reproductive zoöns originated in the mesoderm. As larval forms, the spermatocysts would inherit the tendencies to spontaneous fission of the nucleus at earlier stages in the successive forms, and the resulting cells or fertilizing elements would acquire the capacities and the habits of the full-grown ancestors, if they also are larval forms. The parallel between the encystment of the spermatocyst in the sponge tissue, and of the adult among Protozoa is closely similar. The process of spontaneous fission takes place in both bodies in similar way after their encystment.

[1] **Since the above was written we have received Biologisches Centralblatt for March 1st, 1884, in which Bütschli,** the noted student of Protozoa, announces that a colony of Volvox has male **and female zoöns as individuals, and that the male pro-**duces by division secondary forms which, like spermatozoa, seek out and fertilize the female. Thus Bütschli has discovered the intermediate forms with males and females required by the hypothesis above, and adds exactitude to our theoretical comparisons of the spermatozoa, since in Volvox we have a directly transitional male form, and also, we may add, in Vorticella. We cannot, however, at all join Bütschli in regarding the spermatocyst and the ovum as the morphological representatives respectively of the exclusive male colonies and female colonies of some Protozoa like the Endrina. This would be assuming every cell to be primarily unisexual, either male or female, our standpoint being with Minot and Balfour, that they are primarily sexless or bisexual, that is hermaphrodites, and the sexes the result of independent differentiation.

The products in both cases are the tailed locomotive forms, which are, according to all observers, probably true single cells, which, from the earliest period of their discovery, have been compared or identified with the locomotive monads, the products of the encysted stage in many of the Protozoa.

The essential difference between a spermatocyst and its homologue among Protozoöa consists in the fact that the latter has to become a full-grown feeding zoön before it is ripe, and proceeds to produce by division secondary males, which seek out the female for the purposes of impregnation, while the latter, as its descendant, has acquired by concentration of development, the same powers and habits in its earliest stage, and its sole function is to become encysted and produce larval male cells for the impregnation of the female zoön or ovum. The impregnation in both cases immediately precedes the reorganization of the nucleus of the female (ex. Vorticella), and are followed by a period of reproduction by division, which is infinitely more concentrated in the encysted ovum, as an encysted larval form, than in the free adult Protozoön. The former is thus a builder of close-set tissues composed of larval cells, and the latter of loosely associated colonies of adult feeding zoöns.

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THE NATURALIST BRAZILIAN EXPEDITION.

Paper III.—São João do Monte Negro.

BY HERBERT H. SMITH.

(Continued from page 1014, October number, 1883.)

ABOUT the middle of February we changed our residence to the village of São João do Monte Negro, which lies on the Rio Cahy, a northern branch of the Guahyba. Small steamboats run up this river from Porto Alegre nearly every day, touching at the various German colonies along the banks, and bringing down mandioca-meal, corn, beans, tobacco and other products.

The Cahy is very crooked, and the lower portion is bordered by a wide flood-plain. The clay banks are steeply cut, and often thirty feet high, so as to be beyond reach of all except the strongest floods. They are covered in many places with heavy forest, leguminous trees and myrtles being abundant; the branches are draped with vines, and palms of one or two kinds are often

seen, so that the scenery reminded us much of river-shores in equatorial Brazil.

Twenty-five miles in a direct north-west line from Porto Alegre, but fifty as the river runs, the flood-plain is greatly narrowed, and picturesque hills appear on either side; these are outlyers and denuded portions of the table-land farther north; near São João none of them exceed 800 feet in height. The village itself lies on a higher portion of the flood-plain, at the foot of one of the hills; only a few of the houses and the Catholic church are on a spur of the highlands. The Cahy being subject to heavy floods, the streets are often overflowed, and once or twice a year the houses are invaded; for this reason many of them have an upper story to which the inmates can retire when the ground floor is covered with water. Notwithstanding these frequent inundations the place is notably healthy, malarial fevers being quite unknown; colds and lung diseases are occasionally prevalent, but only during the cold weather. Nearly all the people of São João are Germans, and the German language is much more frequently used than the Portuguese; there is a German Lutheran church, and a German school where many of the children appear in the characteristic peasant costumes of the Fatherland. But for the whitewashed and tile-roofed houses scattered irregularly along the unpaved streets, and the semi-tropical scenery around the place, one might fancy that São João was a country village in Germany.

We resided at first with some German friends, but after a few days we hired a house, arranging to have our meals brought in from a neighboring hotel. Here we lived quietly for several months, making very extensive collections of the animals and plants of the surrounding country. The colonists soon learned that we paid good prices for any animal which they brought us, and even for snakes and insects, and some of them came nearly every day with specimens to sell; in this way we secured many rare species. After awhile we hired two young Germans as hunters and general servants, and these afterwards accompanied us in our travels. Our house resembled a laboratory; we had improvised rough board tables and shelves for our work, and they were generally crowded with jars of snakes and fishes, boxes of insects, botanical presses and so on. An outhouse which had been built for a kitchen was used for rougher operations, such as skin-

ning large animals and boiling and cleaning bones. Our daily life was varied only with new excursions, or with those pleasant excitements which attend the discovery of some rare species or interesting fact. Yet it would be hard to imagine a more agreeable existence than that which we led; our house was a real home to us, and our warm-hearted German neighbors became fast friends; in the end we were very sorry to leave them.

The country around São João is properly a forest region, but this varies much in its characters. On the hillsides it is very heavy, averaging eighty feet in height; the trees and plants, in the main, are of the same species as those found at Rio de Janeiro and in the Brazilian coast range. I noticed only two kinds of palms (a Cocos ? and a large, spiny Bactris, the latter growing only in swampy places); woody climbers are numerous, and there is much underbrush. Ravines and water-courses are so matted over with bushes and vines that one may often walk on top of the vegetation, several feet above the ground.

The river shores and higher portions of the flood-plain have a vegetation which resembles that of the hillsides, but many of the trees are of different species, and they are generally more spreading in their growth, the branches being covered with parasites and trailing lichens; there is comparatively little undergrowth, and one may walk readily almost anywhere without cutting a path. Probably this paucity of smaller plants is owing to the periodical floods, which are unfavorable to them. Most of the herbs which cover the ground in such places are annuals.

A third kind of forest is the *fachinal*, or "faggot-woods," found on dry, sandy soil, generally rather low land, but above the limits of the highest floods. It is composed of low, gnarled trees, either a continuous wood or forming clumps in open ground. They are tangled but not dense, and the ground beneath is covered with grass and dry ferns. Nearly all the plants of the *Mato fachinal* are distinct from those of the hillsides and alluvial plains, and where the fachinal adjoins other forest the limits are always well marked. In their general features these low woods reminded me of those seen in the interior of Brazil, back of the coast range; probably they may be considered as outlying portions of the latter.

Lower parts of the alluvial plain are occupied by meadows, which are often swampy or half flooded; they form excellent

pastures, though the horses and cattle are often obliged to pass many days with their feet in the water. The flowering herbs of these meadows were very interesting; but botanizing on them and in the fachinal forest was rendered difficult by spiny bromelias, which covered the ground in many places. Ditches lined with these plants were generally used by the colonists in lieu of fences.

To the north of São João the fachinal and meadows disappear almost entirely, and the whole country is covered with lofty forest. This is continuous with that which clothes the whole coast range, but on the northern table-land it is broken by large tracts of grass-land.

Passing south-west from São João, about three miles, the forest all at once disappears, giving place to rolling prairie like that which we saw at São Jeronymo. The change is very sudden and striking, and coming as it does unexpectedly, the effect is almost magical. Riding out of the silent woods, a new world leaps into view; a world of great open landscapes, of rippling light, of glorious sweeping winds; a world where every animal and every plant is different from those of the forest which we left behind. So far as the fauna and flora go, this is, in fact, the end of Brazil. From this point the prairies extend, with hardly a break, away to the Rio de la Plata, and beyond it almost to Cape Horn. Only in a few favored places the forest reappears in small patches, Brazilian islands in the pampean ocean.

The geology of the São João district is rather uninteresting. The hills to the north and west of the village are composed of soft, friable, reddish-brown sandstone, which by intrusions of basaltic and other igneous rocks has been thrown into irregular flexures. The lower portions are soft and often shaly, and as they are more readily washed away the harder upper layers are left in picturesque cliffs. These sandstones and sandy shales show a section of at least 800 feet, and probably they are much thicker. On the Serra de São João, near the village and elsewhere, the harder upper layers are quarried, the stone being used in Porto Alegre for sidewalks and for facings; it is, however, too soft to be of much value.

In this hill the strata dip north-east at an angle of about 15°; elsewhere they present almost every possible strike and inclination. From information which I have, it would appear that the

same sandstone extends northward almost to the limits of Santa Catharina. From the position of the beds there can be little doubt that they lie above the coal rocks of São Jeronymo, but beyond this I know nothing of their age. Careful search was made for fossils but without success.

The Monte Negro is a singular cliff-crowned hill about 800 feet high, lying near the river-shore about two miles south of the village; it derives its name from the somber color of its forest-covered sides when seen against the open campos. This hill is composed of a singular dark porphyritic rock, originally an eruptive mass which cut through the sandstone; by the denudation of the latter it has been left standing like a tower, the upper part rising perpendicularly, while the base, covered with talus, slopes away steeply to the plain. Other hills in the vicinity are formed of the same rock, or of basalt; where these occur in low, damp places the decomposition has sometimes given rise to agates like those of São Jeronymo.

The flora of the country around São João is exceedingly rich My wife, to whom the botanical collections were relegated, devoted herself especially to ferns, gathering no less than 135 distinct species.[1] Among these were four or five tree-ferns, and many very large brakes. The fachinal forest contained a peculiar set of dry, stiff-looking species; others grew on the branches and trunks of trees and in shady ravines. But by far the richest collecting places were the sandstone cliffs. Where streams fell over these they often presented magnificent pictures, great tree-ferns mingling with giant brakes, and lesser species carpeting the rocks or hanging in fairy curtains from some projecting ledge. Many of the species take root at the ends, and we found one true "walking-fern," which was regularly propagated in this way.

The settlers speak of over fifty kinds of excellent timber in the forest, and there are probably three times as many less valuable species. I made a collection of about seventy-five kinds, many of which were equal in beauty to the finest cabinet woods used in the United States. With the present increasing taste for all ornamental work, it is hardly possible that these fine Brazilian woods should be long neglected.

Our collections, both of vertebrates and invertebrates, were

[1] Two hundred and fifty species have been collected at Rio de Janeiro, probably more than at any other one point in the world.

very large, but I will speak here only of the Mammalia. Of monkeys I heard of only four kinds, three of which we secured. The largest and commonest is a howler, called here *bugiu*;[1] it varies in color from a very dark reddish-brown to a bright red or almost ochre; the light-colored specimens are always the older ones. The largest individual which we obtained was an old male which measured just two feet from the nostril to the root of the tail, the tail itself being twenty-five inches long; the girth was fifteen and a-quarter inches. The bugius wander in considerable bands, nearly always among the branches, but occasionally on the ground; they eat the fruits of forest trees, and perhaps birds' eggs and insects. The females commonly have two young at a birth, and these, when traveling, cling to the long hair at the back of the mother's neck; when sucking they are generally seated on a branch before her. This species wanders only in the daytime, sleeping on boughs at night.[2] The peculiar bony enlargement of the larynx, by which the hoarse cry or howl is produced, is fully developed only in the males, the females being nearly dumb. When traveling the males of this Rio Grande species are also silent; the emission of the cry is accompanied by a kind of dance in which the whole tribe takes part. This occurs sometimes during the day, sometimes at twilight, but in any case the figure of the dance is the same. The males leap rapidly, from branch to branch, in a circular direction, generally by following the outer boughs of some large tree; the females form a larger circle around the males. While moving the males give forth their peculiar cry, and the whole troop appear to be much excited; the performance may last half an hour.

The howlers, it is said, can never be thoroughly tamed; in captivity they are morose and treacherous, often biting severely. There is a black *Ateles* found in the same forest, but much less commonly than the bugiu; of its habits in a wild state I know nothing, but tame individuals are sometimes seen, and these are very gentle and intelligent. Young ones have a curious resemblance to human babies, amusing themselves with bits of straw or sticks, and moving their long arms helplessly; when scolded or struck they give vent to doleful cries, but never attempt to

[1] *Guariba* on the Amazons.

[2] One of the Amazonian species certainly wanders during the night. More than once, when camping near Santarem, I have been awakened by the howlers which passed overhead with their usual hoarse cry.

scratch or bite. They are very fond of caresses, and will lie quite still to receive them, crooning a little in a ridiculously satisfied way. I knew a tame Ateles of another species which always met one with an embrace around the neck; this was not an acquired trick, but simply the natural expression of its affection for human beings.

One individual of a large *Cebus* was brought in; it was a great rarity, and none of our hunters recognized it at all. There is a smaller monkey occasionally seen here, which I judge to be also a Cebus, but we did not obtain specimens. The marmosets do not seem to be represented, at least in the eastern part of this province.

Bats were rather common, but by no means as numerous as in equatorial Brazil, and none of the species which we obtained were very large. So far as I could discover, the blood-sucking kinds are unknown here.

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THE EXHALATION OF OZONE BY FLOWERING PLANTS.

BY J. M. ANDERS, M.D., PH.D.

(Continued from page 344.)

IT became evident that in order that this important question might be set at rest, the conditions would have to be varied and further observations instituted. I now set to work to devise the necessary apparatus to carry on such experiments. Accordingly I had made a glass case large enough to contain a dozen or more thrifty growing plants in pots. Its dimensions were as follows: length, three and a half feet; width, two and a half feet, and height, two and a half feet. A portion of the top was left removable, so as to furnish an aperture through which the plants could be placed in the case and again taken out. Such an arrangement as this would admit the sunlight to the plants and confine their exhalations, and thus give the ozone, if any should be generated, a better opportunity of acting upon the test papers. In all of the remaining experiments here recorded I was greatly assisted by Mr. G. B. M. Miller, my medical student. The apparatus was first placed in the bay window of an occupied sitting-room facing east. The plants here received the sun's rays for at least six hours of the day. A dozen thrifty plants were placed in the

case, which was then accurately closed by the removable piece of glass already spoken of; the test papers having been moistened and tacked on the branches or stems of the plants. In the first series of experiments flowering plants were used, twelve in number, each having several flowers and about four square feet of leaf surface. They consisted of varieties of geraniums, fuchias, begonias, hydrangeas and petunias. Upon these plants eighteen observations were made of about four hours each, during the latter part of the month of May, 1883; weather mostly fair. The Schoenbein showed "very slight" indications for seven of the experiments and one "slight" coloration, there being ten negative results. The guaiacum papers gave more striking results, the change in the papers being marked for ten of the experiments and slight for the remaining trials, save one which was negative. Great care was taken to keep the plants experimented with in a healthy condition; they were also left in the pots in which they had been grown. There are two reasons which can be assigned why the results in these experiments were not very striking with the iodized starch test First, the experiments were of too short duration; and secondly they were conducted indoors, for the air of the case was originally the air of the room, and a portion at least of the ozone which might have been generated by the plants would have been decomposed by the impurities of the air in the case.

With a full knowledge of the very unfavorable conditions under which these experiments were conducted, but encouraged by their moderate success, it was resolved to make a trial of odoriferous flowering plants under the same conditions. Again our little floral chamber was filled with plants, consisting of seven rose bushes, four carnation pinks, and six heliotropes. The duration of observations about ten diurnal hours each; weather mostly clear, two days cloudy. With the Schoenbein test there were "very slight" reactions in most instances, two "slight" and one well "marked," while the guaiacum papers were "marked" in most cases, a couple being "slight." The number of experiments were eight. These investigations suggested the idea naturally that odorous flowering plants might be better ozone generators than inodorous ones. The external atmospheric conditions were very similar during the time of both the preceding sets of experiments, the maximum temperature ranging

from 85 to 88° Fahr. Repeated testing of the atmosphere of the room in which the case was situated gave no indications of the presence of ozone.

The question now very naturally arose whether the colorations were due to ozone or to some of the substances which give the same reactions with these papers; hence, further investigation was necessary in order to exclude, if possible, these interfering conditions, before it could be claimed for plants that they were capable of emitting or converting the oxygen of the air into ozone. It was also deemed important to conduct future experiments out of doors as, for reasons already given, it was expected more decided results would be obtained. The case was removed to the back yard, which lies to the eastward of the dwelling. Here the plants received the sunlight for at least eight hours daily during clear weather, and the yard was of good size. In the first series of experiments in this locality the plants last named were employed.

After observations for seven consecutive days of clear weather the Schoenbein paper gave "slight" reactions in four cases and "marked" reactions in three. The guaiacum paper gave "slight" indications in three and "marked" in four experiments. It will be seen that these experiments gave more marked results than those made within doors. It may be stated that it was found that the coloration of the Schoenbein or iodized starch test was "slight" instead of "very slight" as indoors, and in three cases actually "marked," against one "marked" result in the preceding series. The guaiacum tests were nearly correspondingly more marked. It is probable that the more surprising results of the last series are not attributable solely to the change of location but also in some degree to the fact that the experiments were of longer duration. A piece of red litmus suspended in the case during these experiments gave no indication of the presence of ammonia. Peroxides of hydrogen could not have been the reactionary agent, since that substance is decomposed at a temperature of 70° Fahr., while the temperature of the atmosphere within the case, which was carefully noted, was never found below 90° Fahr. These observations were made during the first week in June, 1883, the weather being very warm and the temperature of the air within the case being higher than that of the external air. Good reactions were, however, obtained in later experiments

when the temperature did not mark over 70° Fahr. That the reactions were not due to the nitrous oxides, perhaps the only remaining substances capable of producing like colorations of these test papers, will appear evident hereafter.

It was next proposed to give foliage plants having soft thin leaves a trial. Seven asperdisteus, one fern and three dracænas were chosen for experimentation. These observations were conducted during the first week in September, 1883, for seven consecutive days. The weather was extremely warm, the temperature of the air within the case ranging from 85 to 100° Fahr., the sky was clear during four days and partly cloudy the remaining three. The Schoenbein test paper gave negative results throughout, while the guaiacum gave one "very slight" reaction, the rest being negative also. Thus it would appear that foliage plants have not this power of generating ozone, the function must therefore reside with the flower, but of its nature we shall speak hereafter.

As our first experiments with inodorous flowering plants did not yield results striking enough to afford a basis for positive conclusions, it was considered desirable to apply the tests to them in the open air, which was done. Seventeen thrifty geraniums were employed. The temperature was lower during these experiments than during those made indoors with inodorous plants. For six consecutive days, experiments being of ten hours each duration, the Schoenbein gave one negative, two "slight" and three "marked" blue shades. The negative result occurred upon a rainy day, during which there was no sunshine whatever. This would indicate that sunlight, or at least good diffused light, is essential to the generation of ozone by plants, for the plants were protected from the rain by the glass. There are other physiological processes carried on by plants which are almost entirely dependent upon the power of the sun's rays, *e. g.*, assimilation and transpiration. To the above may doubtless be added the development of ozone.

Observations were continued upon these plants during the second week of September, the result being about similar to those last noted, the Schoenbein gave two "marked," one negative, on a rainy day, and the rest "slight" reactions. The guaiacum papers gave two "striking" and the rest "slight" colorations. As already intimated nitrous oxides, which are present in the air,

change the color of these test papers very much as ozone does. To exclude the possibility of the change in color being due to the nitrous oxides, we tested the air during the latter set of experiments on the outside of the case simultaneously, and found that the papers in this situation gave only one "slight" reaction, and even though this occasional reaction on the exterior had been due to the presence of the nitrous oxides, they could not have caused the much more striking and constant tests obtained on the inside. Again, it is not at all likely that the plants generated nitrous oxides, which in turn might have changed the test papers, for there is nothing in all vegetable physiology to support such an hypothesis. Moreover, it is all the more improbable that nitrous oxides caused the blue colorations, since they did not do so *when foliage plants were employed.*

We do not wish to say dogmatically that all the changes in the test papers were due to ozone, but from the many beautiful reactions obtained, and the systematic precautions taken to preclude the action of other substances known to answer to like tests, it will not be denied that the chief agent in changing the papers was ozone. I was unable to detect the odor of ozone upon which Professor Leeds lays so much stress, but Mr. Miller thought he could detect its presence. It must be borne in mind that the amount of plant life within the case was probably too small to generate sufficient ozone to make it perceptible to the sense of smell.

It would appear certain from these experiments, that the leaves which are so actively engaged in carrying on the important functions, as, for example, transpiration, have nothing whatever to do with the production of ozone. But, on the other hand, it is to the flower that is delegated this highly important, though perhaps hitherto unthought of, function in plant life.

Can we, from the facts derived from these observations, come to any definite conclusions respecting the nature of this function? Is the cause to be sought in the functions of the petals or in the formation of the seed? Let us here recall how ozone can be produced artificially, and it will be remembered that one mode is by suspending phosphorus in moist air. Now it is known that the ashes of seeds contains large quantities of the phosphates. It follows that during the formation of the seeds there is a rapid metastasis of phosphorites in the form of phosphoric acid and

the phosphates to that organ of the plant, and it may reasonably be supposed that in the chemico-vital changes going on in the ovules, phosphorus is liberated and acted upon by the moisture which the leaves and petals are so actively transpiring.

As corroborating this view we may allude to the phenomena of phosphorescence in plants as observed by M. Crié and others. In a communication to the French Academy, M. Crié states: "It is well known that the flowers of phanerogams are capable, under certain circumstances, of producing phosphorescent light. The phenomenon has been verified, especially of the nasturtiums and the marigold. Some years ago I myself saw phosphorescent light emitted in stormy weather from the flowers of the *Tropeolum majus* cultivated in a garden." Although an absolute decision may not be possible, the above facts, when taken together, are suggestive of the correctness of this explanation. The subject, however, merits further investigation.

In the light of the present experiments there can scarce be a doubt but that a manifest relation does exist between vegetation and the ozonic condition of the atmosphere. And this, it will be conceded, is not the least hygienic influence possessed by plants. During fair weather all flowering vegetation in nature is contributing ozone to the atmosphere. In this connection it should be borne in mind that vegetation is largely blooming, that numerous field plants, the forest trees, as well as all fruit trees put forth flowers, and that during this period they all add their quota of ozone to the surrounding medium. Again, not all blooming plants or trees produce their flowers at the same time of the season, so that it happens that there are a certain proportion of different species flowering in turn from early spring till late in autumn, and hence the effect upon the atmosphere with reference to the amount of ozone they give to it must be pretty constant during the whole vegetative period wherever vegetation abounds. We here have another evidence of the fact that in His eternal wisdom the Author of nature has intrusted to plant life the task of maintaining the harmonious composition of the atmosphere. A certain proportion of ozone in the atmosphere is essential to prevent it from becoming too much polluted for animal respiration by the products of decomposition, particularly of azotized substances, which are known to be a fruitful cause of disease, and which are believed by some to serve as carriers for the germs of epidemic and contagious diseases.

Upon this point Professor Kedzie observes: "I call ozone the most energetic of the constituents of the atmosphere. Its presence or absence must have a *controlling influence over the vital powers.* And when we consider that this material is present in such variable amount in a medium which enfolds us every moment of our lives, and where action 'pauses not for matin or for vesper, at noon of day or noon of night,' it seems to me that no one can deny that its influence on human health must be most significant."

Professor Max von Pettenkofer says of the hygienic value of ozone in the air: "It is the constant purifier of the atmosphere from all organic matter which passes into it and might accumulate. The air would have been long ago filled with the vapors of decomposition if it were not for ozone, which oxydizes all that is oxydizable, if only time be allowed for it and too much is not expected at once."[1]

How long it would be possible for animal life to exist were all the atmospheric ozone to be suddenly annihilated, cannot be computed; but that existence would sooner or later become impossible on account of noxious substances which would accumulate in the air, and which it is the office of the ozone to destroy, cannot be reasonably doubted. How infinitely wise and benefi-cent, then, is the Author of nature in placing beside these destroying elements the means of reparation. And as flowering plants serve as natural ozone generators, they must be looked upon as worthy of being placed in the front rank as hygienic agents.

Perhaps the most interesting phase of this question is the application of the results of our observations to the beneficial effects of the cultivation of plants in dwellings. As already incidentally mentioned, ozone is not detectable in living rooms for the reason that it is decomposed in oxydizing the organic matter present. It was also seen that flowering plants generate ozone indoors during clear weather, and if a dozen thrifty plants, in a case of the dimensions of the one employed, give us a reaction, then it will not be doubted that a living room well stocked with flowering plants would give off sufficient to be of hygienic value, since it is well known that we rarely or never find but a small quantity in the external air, which yet serves to maintain it in a salubrious condition. The air of dwellings is very generally charged with

[1] *Popular Science Monthly*, Feb., 1878.

deleterious substances due to human respiration, insufficient ventilation, the presence of sewer gases, and many other causes. That the hygienic conditions of the air of living rooms is almost universally abominable is admitted by the best authorities, and it is also true that this bad air of our dwellings serves admirably as a culture fluid for the various disease-producing germs. How to obviate the ill effects arising from this unfortunate condition of things is a question of paramount importance. Since plants are capable of generating ozone, which has the power of destroying not only the organic impurities but even disease germs, it follows that the requisite amount of flowering plants grown in our living rooms would, in a great measure, rid the air of these deleterious substances. From these observations it will readily be conceded that the value of house-plants as hygienic agents can scarcely be overrated. That no possible objection can be urged against the practice of keeping blooming plants in our living rooms (excepting in the case of those having pronounced odors, as the tuberose, etc.) has been shown conclusively elsewhere, and the old time prejudice, we are happy to be able to state, is rapidly dying out.

Shall we discard the foliage varieties because they are incapable of producing ozone? By no means; there are also important advantages to be derived from their presence. Not to speak of their æsthetic influence, there is, as already pointed out, confided to the leaf the important function of transpiration or exhalation of watery vapor. This process is carried on so actively by leafy plants as to give them the power to raise the degree of humidity of a closed apartment which is usually far below the health standard, as the writer has shown in previous articles.[1] It simply remains to be said that, in view of these experiments, the flowering treasures of the green-house as well as foliage plants should be welcomed into every household as being among our noblest sanitary agents.

[1] "Transpiration of Plants," AMER. NAT. for March, 1879; also "Beneficent Influence of House Plants," AMER. NAT. for Dec., 1879; also "Hygienic and Therapeutic Relations of House Plants," *Phila. Med. Times* for May 8, 1880.

THE CREODONTA.

BY E. D. COPE.

(Continued from the April number, page 353.)

THE genus Ictops is found from the Bridger epoch up into the Oligocene or White River Miocene. It thus has much the range of the genus Hyænodon. There are three species, of which I give a cut (Fig. 21) of the *I. bicuspis* Cope, from the Wind River beds of

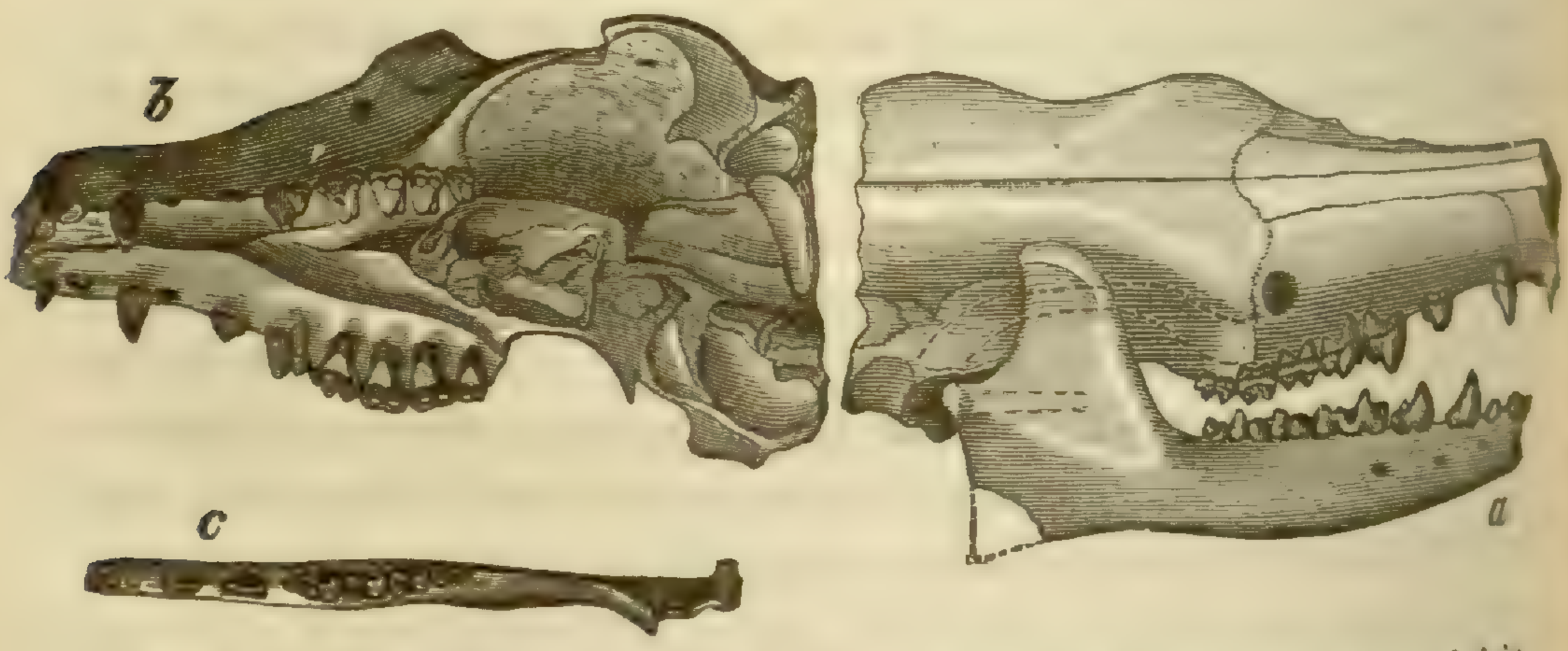


FIG. 21.—*Ictops bicuspis* Cope, skull, natural size. Fig. *a*, oblique view of right side; *b*, do. of inferior side, injured posteriorly; *c*, mandibular ramus from above. From the Wind River Eocene, Wyoming. Original, from Report of U. S. Geol. Survey Terrs., Vol. III.

Wyoming. In this form, as in Leptictis, the incisors and canines are spaced. The White River species is the *Ictops dakotensis* Leidy. But one species of Mesodectes is known, the *M. caniculus* Cope, from the White River beds of Northeastern Colorado. I discovered a good deal of its skeleton, which furnishes an idea of its general characters. Its skull, like that of the *Leptictis haydeni* Leidy, possesses the marsupial character of a subsquamosal foramen (Fig. 22 *ss*), but the resemblance to this order includes besides only the dentition. There is a large keeled præsternum, stouter and shorter than that of a mole, suggesting a burrowing habit, but the humeri are not robust. The neck is very short, and the cervical vertebræ are without neural spines. The cerebral hemispheres of the brain leave the olfactory lobes and the cerebellum entirely exposed, and are wide and short. They are smooth, but the sylvian fissure is visible. This animal was about the size of the European hedgehog (*Erinaceus europæus*).

As yet but one species of Leptictis is known, the *L. haydeni*

Leidy (Fig. 22). This animal has been found in the White River beds of Nebraska. It is about the size of the *Mesodectes caniculus*. It resembles the gray fox of North America in the rib-like temporal ridges of its skull.

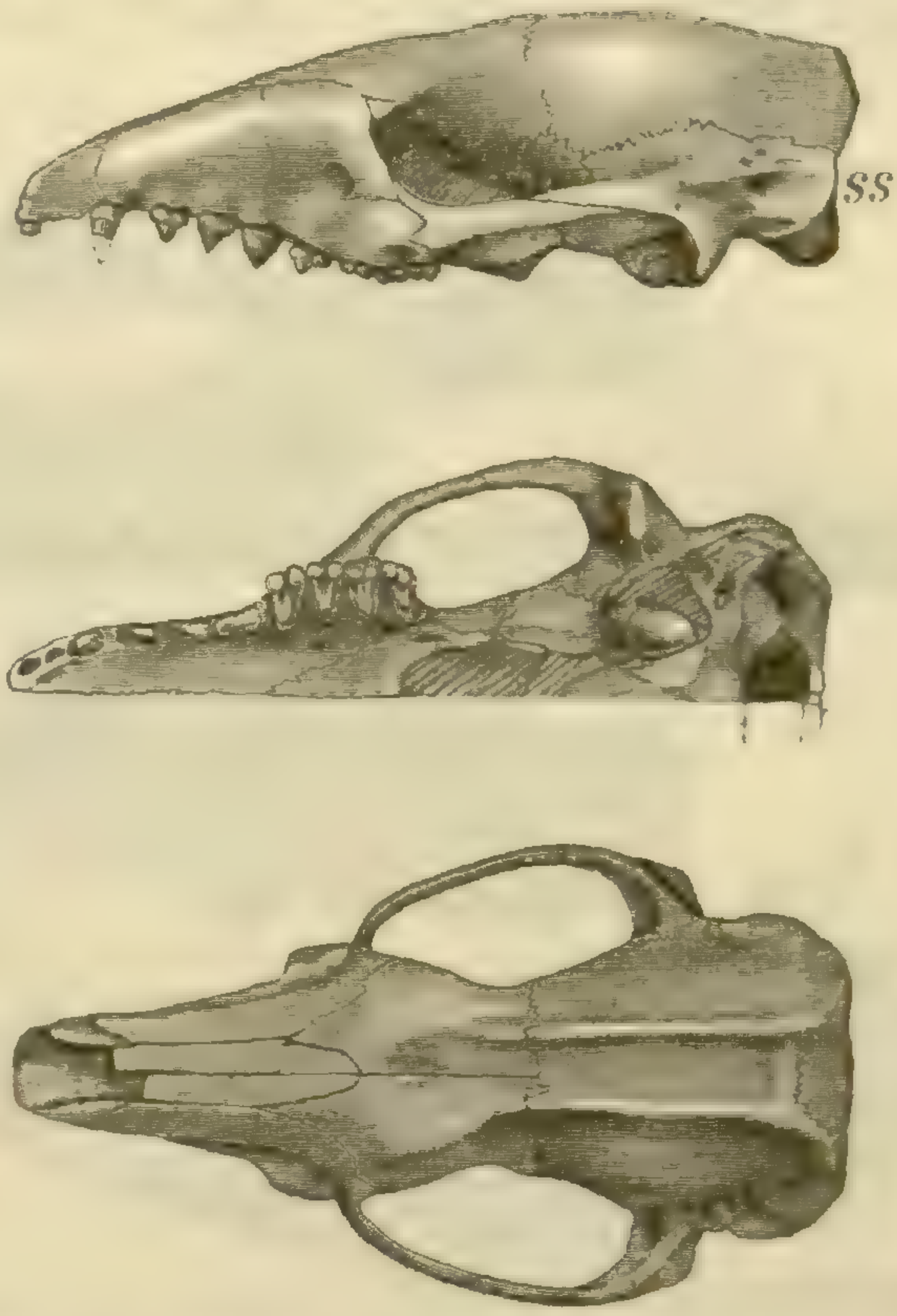


FIG. 22.—*Leptictis haydeni* Leidy, skull, natural size, from the White River beds of Nebraska. From Leidy, Extinct Mammalia of Dakota and Nebraska. *ss*, subsquamosal foramen.

The remarkable genus which I have called Esthonyx, is exceptional in the family in the large development of its second inferior incisors at the expense of the others. One or more of the superior incisors has been supplanted by the large development of the one that remains. The canines are moderately reduced, and the premolars are $\frac{3}{3}$ (Fig. 23). The last premolars of both jaws are more or less like true molars. The inferior true molars support two V's, of which the anterior is the more elevated. A good deal of the skeleton of the *E. burmeisteri* Cope, is known. Its distinct scaphoid and lunar bones are represented in Fig. 24 *b b'*. It had five digits in the manus. The cervical vertebræ are more robust than the dorsal, and the tail is long and large. The characters of this genus approximate it to the true hedgehogs (Erinaceus), and I formerly placed it in the same order. The tritubercular superior molars separate it widely. Nevertheless I suspect that it stands in ancestral relation to the Erinaceidæ.

I have described five species of this genus, of which two are from the Wasatch of New Mexico, two from the corresponding beds of Wyoming, and one, *E. spatularius*, from the Wind River bed of Wyoming. *E. acutidens*, of the Big Horn region, is the largest, equaling a red fox in the size of the skull. The skeleton of *E. burmeisteri* shows, however, that, as in other Creodonta, the

limbs are smaller in relation to the skull than in modern Carnivora. The least species is the *E. acer* of New Mexico.

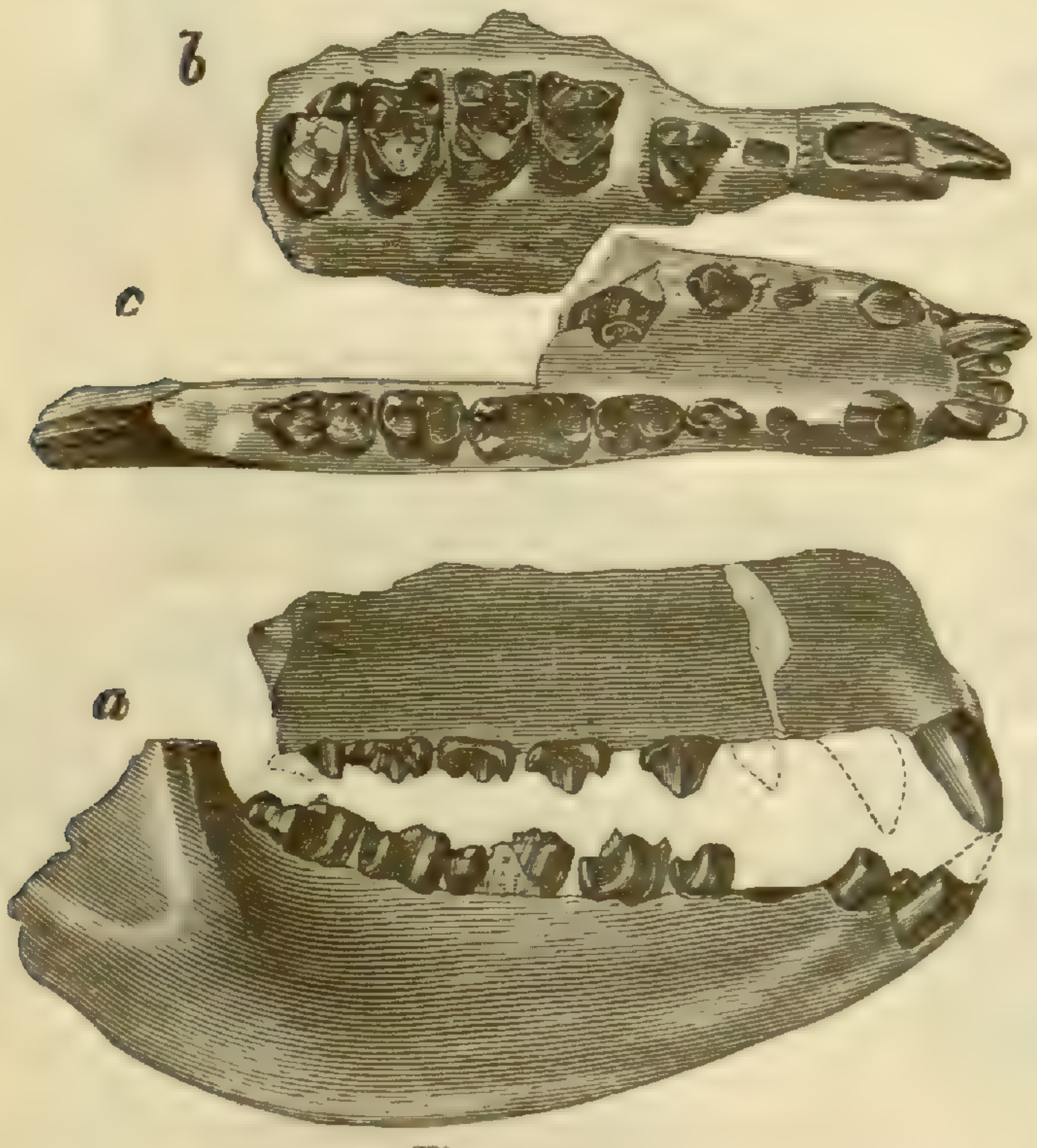


Fig. 23.

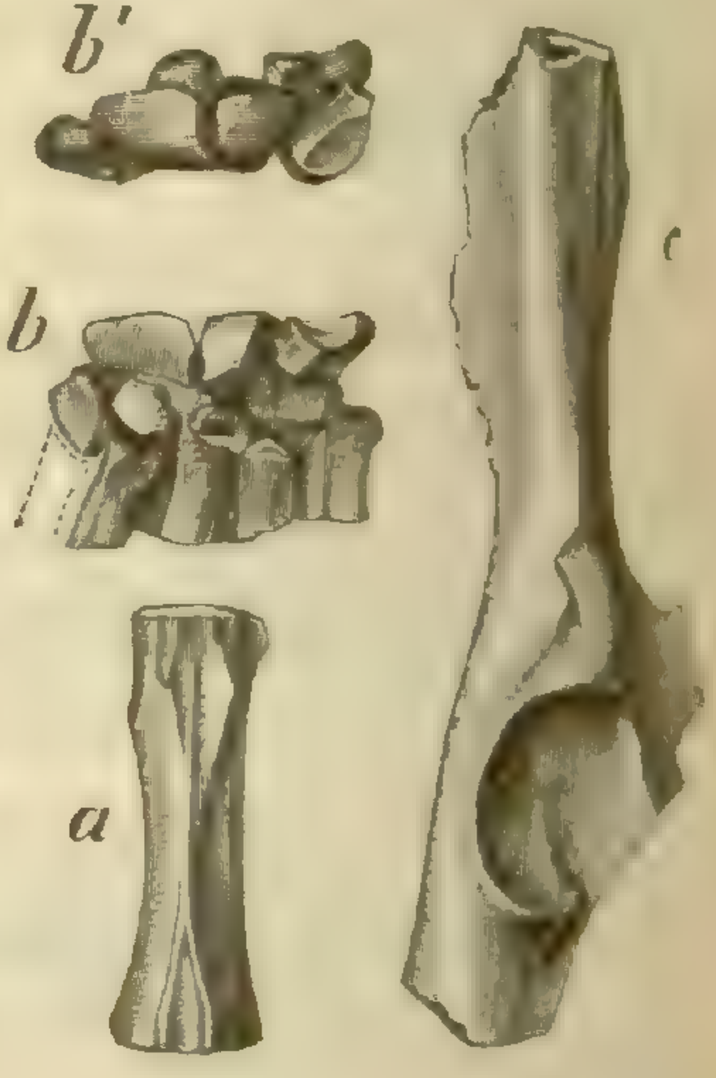


Fig. 24.

FIG. 23.—*Esthonyx burmeisteri* Cope, part of skull with lower jaw, from the Wasatch epoch of the Big Horn, Wyoming, two-thirds natural size; Fig. *a*, lateral view; *b*, inferior; *c*, superior views. The superior jaw consists of two pieces. FIG. 24, bones of specimen represented in Fig. 23, same proportions. Fig. *a*, caudal vertebra; *b*, carpus from front; *b'*, do. proximal view; *c*, part of innominatum, external view. Original, from the Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol. III.

OXYÆNIDÆ.

The genera of this family are best explained by the following analytical table. The pertinence to it of the genus Thereutherium Filh., is not certain. The only genera which present the character of the narrow transverse third superior true molar, are Oxyæna and Pterodon.

I. Inferior molars with three anterior cusps.

Cusps obtuse; fourth premolar with tubercular heel; formula $\frac{3}{3}\ \frac{3}{3}$ ..... *Palæonictis*

Cusps acute; heel of fourth premolar cutting; formula $\frac{3}{4}\ \frac{3}{2}$ ..... *Oxyæna*

II. Inferior molars partly tubercular-sectorial, partly sectorial.

Superior molars unknown..... *Pterodon*

[1] These characters are derived from an examination of the type of DeBlainville preserved in the Mus. Jardin des Plantes, which the permission of Professor Gervais enabled me to make. Other characters of the fourth premolar, which I have hitherto copied from others, are inexact.

III. Inferior molars sectorial.

Last superior molars transverse; others with two median cusps; formula $\frac{3}{3}$ $\frac{3}{3}$,
Pterodon.

Last superior molar subround; others with one median cusp; formula $\frac{3}{4}$ $\frac{3}{2}$,
Thereutherium.

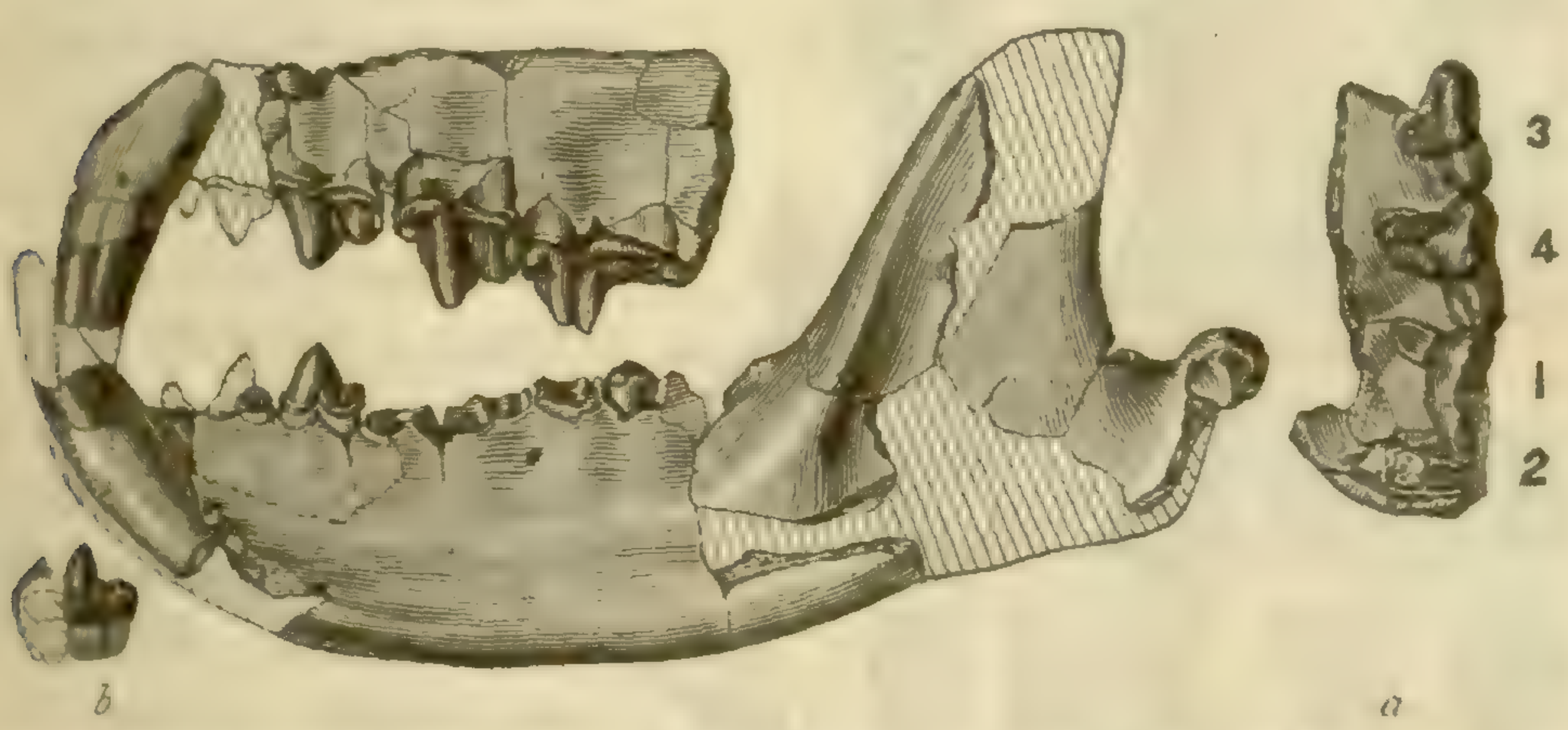


FIG. 25.—*Oxyæna lupina* Cope, jaws, one-half natural size, from the Wasatch beds of New Mexico. Fig. *a*, maxillary bone with teeth, from below; *b*, last superior molar, from behind. Original from the Report U. S. G. G. Survey W. of 100th mer., G. M. Wheeler.

Of the above genera Oxyæna and Protopsalis only are American. Thereutherium Filhol, includes a species, *P. thylacoides*, with a skull of the size of that of a skunk, which has been obtained from the Phosphorites of France. There are two species of Pterodon, both robust flesh-eaters. The *P. dasyuroides* of De Blainville is one of the longest known of the Creodonta. The *Palæonyctis gigantea* Blv., is found in the plastic clays near Paris. Its dentition approaches that of Amblyctonus.

The Oxyænas have the characteristic peculiarities of the Creodonta and of the carnivorous marsupials in their general proportions. The head was relatively larger, and the limbs were smaller than in true Carnivora. The feet were plantigrade, and had five toes anteriorly and posteriorly. The hind foot was either divided so that the external two toes opposed the internal three, or were divergent and connected by a median web. If not divided, the entire foot was directed outwards from the line of the calcaneum. In the latter case the hallux may have been opposable, as in the opossum, but in a much less degree. The tail was long and stout (Fig. 26).

Species of this genus were abundant during the Wasatch epoch in New Mexico and Wyoming, and probably over the entire continent. They have not yet been reported from higher Eocene beds, not even occurring in the Wind River. A small species is

found in the Puerco. A species (*O. galliæ*) has been recently detected in the Eocene of France by M. H. Filhol.

The dentition of the Oxyænas indicates sanguinary habits (Fig. 25). From the measurements, which are confirmed by more than one other skeleton, it can be seen that there is in the *Oxyæna forcipata* (Fig. 3, p. 260), a remarkable disproportion between the size of the skull and that of the limbs. While the dimensions of the jaws are like those of the jaguar, those of the limbs do not exceed those of the cheetah, while the digits are not only much shorter, as those of a plantigrade animal, but are more slender. The ungual phalange preserved, shows that the claws had no prehensile power, and were not effective as weapons or for digging. This is a further indication that the species of Oxyæna were aquatic in their habits.

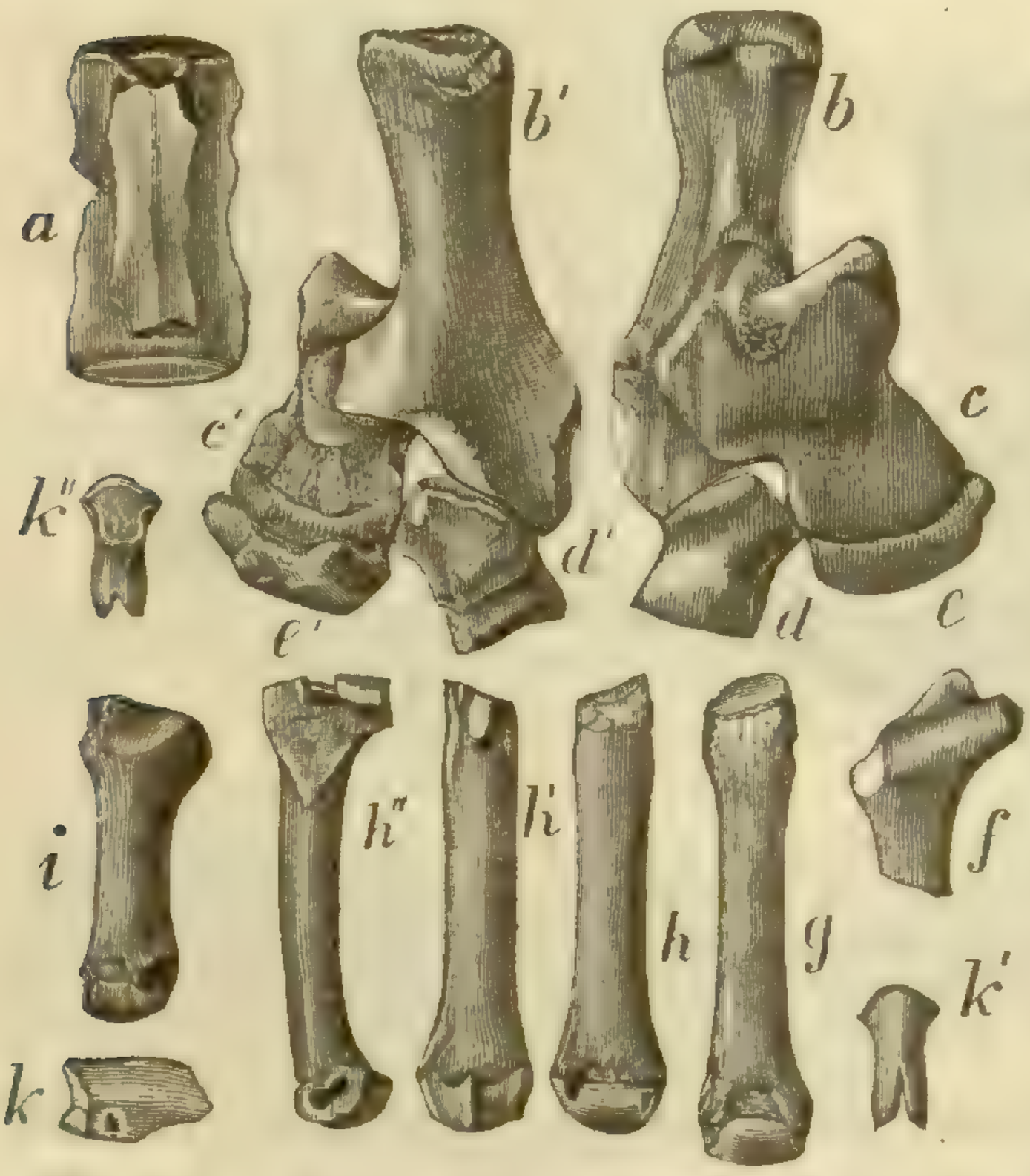


FIG. 26.— *Oxyæna forcipata* Cope, posterior foot and (*a*) caudal vertebra, two-thirds natural size. Figs *b*, calcaneum, *c*, astragalus; *d*, cuboid; *e*, navicular bone; from above; *b' c' d' e'*, the same from below. Figs. *f g h i*, metapodial bones; *k*, ungual phalange from above, right side and below. From the Wasatch beds of the Big Horn, Wyoming. Original, from the Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol. III.

But one species of the genus Protopsalis is known, the *P. tigrinus* Cope, which shares with the *Mesonyx ossifragus* the distinction of being the largest of the Creodonta. It is from the Wind River beds, which possess a fauna mainly of Bridger character, but with an admixture of Wasatch forms.

The form of the sectorial tooth, together with that of the metatarsal, approximates this genus to the Felidæ more closely than to any other family of existing Carnivora. The resemblance seen in the sectorial (Fig. 27 *a*) is, however, probably delusive, as it is not the same tooth as the sectorial of the Carnivora. The resemblance in the metatarsal is real, as the characters are unlike those of Canidæ or Hyænidæ. The feet are evidently larger than in many of the Creodonta, as the proximal extremity of

the metatarsal is as large as that of a lion.

It is possible that the genus Patriofelis of Leidy belongs to this family, but its dental characters are not described with sufficient precision to enable this question to be decided. The inferior molar series is short, including, according to Leidy, only five teeth. The *P. ulta* Leidy, has a jaw the size of the puma. It is from the Bridger beds of Wyoming.

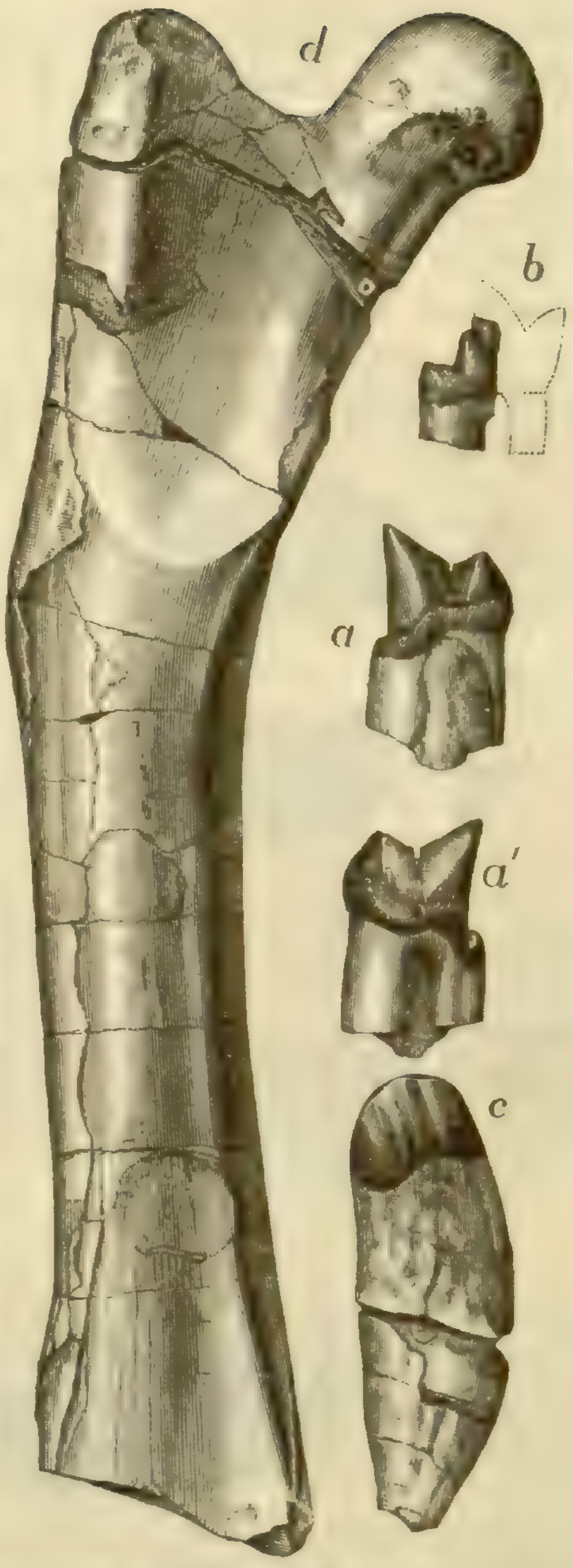


FIG. 27.—*Protopsalis tigrinus* Cope, one-half nat. size. Fig. *a*, probably last inferior molar, innerside; *a'*, external side; *b*, penultimate inferior molar, inner side; *c*, inferior canine, external side; *d*, femur, anterior view. From the Wind river of Wyoming. Original, from Report U. S. G. Survey Terrs., III.

MIACIDÆ.

In this family we have the point of nearest approximation of the Creodonta and Carnivora. This is indicated by the fact that the sectorials of this family are true sectorials, both by position and form, such as are not elsewhere met with in the Creodonta. The genera might readily be taken for members of the Canidæ and Viverridæ, but for the structure of the astragalus, which is thoroughly Creodont. There is no trochlear groove of the tibial face, and in Didymictis it is so oblique that the internal malleolar face looks partly upwards. There are two genera known, Miacis Cope, with two inferior tubercular molars, and Didymictis Cope, with but one.

Five species of Miacis have been described, two of which are from the Wasatch and three from the Bridger beds. The former are distinguished from the latter by the larger size of the second tubercular molar, which has two roots. The later species, of which the type *M. parvivorus* Cope, is one, have but one such

root. None of the species exceeded the gray fox in size, and the Bridger species at present known, are much smaller.

Didymictis has a greater range in time than Miacis. Eight species have been described, two of which are from the Puerco horizon and six from the Wasatch. The genus is probably represented by other species in the Bridger. There are three divisions of the genus. In the first the premolars are not lobed on their posterior margins; here belong *D. primus* and *D. haydenianus* (Fig. 30) of the Puerco. The others have the lobes in question, but two of them, *D. curtus* Cope, and *D. massetericus* Cope (Fig. 29), have a short subcircular tubercular molar, while that

Fig. 28.

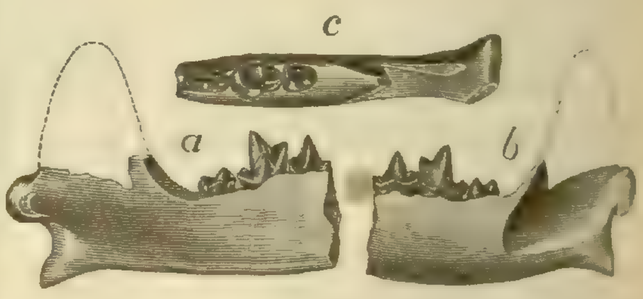


Fig. 29.

FIG. 28.—*Miacis brevirostris* Cope, left mandibular ramus, two-thirds natural size. Fig. *a*, left side; *b*, inner side; *c*, from above. From the Wasatch beds of the Big Horn. FIG. 29.—*Didymictis massetericus* Cope, left mandibular ramus, two thirds natural size, from the Big Horn river, Wyoming. Fig. *a*, inner side; *b*, external side; *c*, superior view. Original, from the Report U. S. Geol. Survey Terrs., Vol. III.

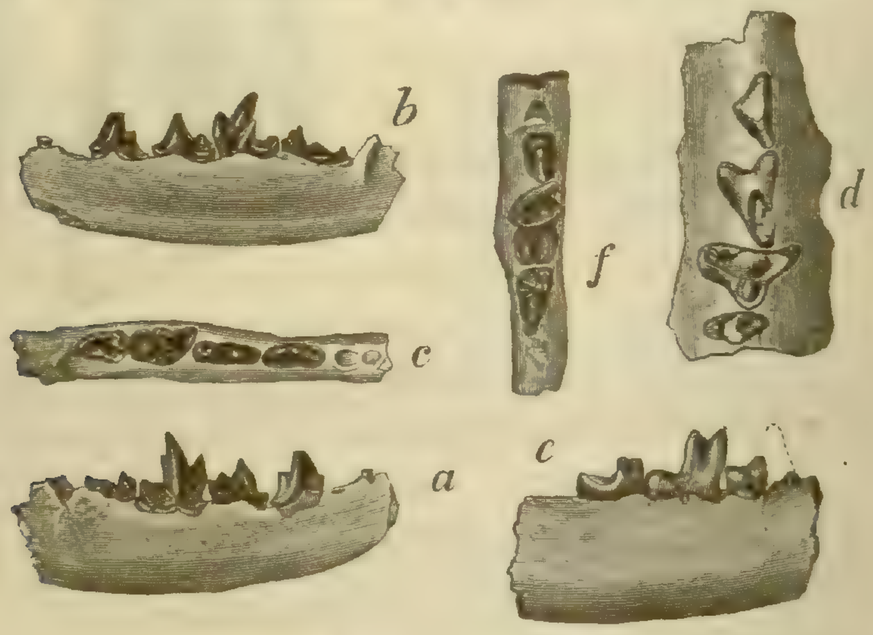


Fig. 30.

FIG. 30.—*Didymictis dawkinsianus* Cope, natural size; from the Wasatch beds of the Big Horn, Wyoming. Fig. *a*, external side; *b*, internal side; *c*, from above. Figs. *d*, *e*, *f*, *Didymictis haydenianus* Cope, jaws natural size, from the Puerco formation of New Mexico. Fig. *d*, maxillary bone with teeth, from below; *e*, left ramus mandibuli, inner side; *f*, do., from above. All original, and from the Report U. S. Geol. Survey, Terrs., F. V. Hayden in charge, Vol. III.

the other species is an elongate oval. The tendency in the genus has been to complicate the premolars and shorten the tubercular in the course of time. The smallest species is the *D. dawkinsianus* (Fig. 30), from both the Big Horn and Wind River beds, an abundant and acute-toothed species. The largest species is the *D. altidens* Cope, whose jaws are more robust than those of the coyote.

I append the following table showing the distribution of the genera of Creodonta in the North American Tertiary formations:

	EOCENE				OLIGOCENE
	Puerco	Wasatch	Bridger	Uinta	White River
Amblyctonus					
Mesonyx					
Sarcothraustes					
Dissacus					
Hyænodon				?	
Miaclænus					
Triisodon					
Diacodon					
Stypolophus					
Didelphodus					
Chriacus					
Deltatherium					
Ictops				?	
Mesodectes					
Leptictis					
Esthonyx					
Oxyæna					
Hyænopsalis					
Patriofelis					
Miacis					
Didymictis			?		

—:o:—

A WALK THROUGH THE NATURAL HISTORY MUSEUM AT FLORENCE.

BY JAMES S. LIPPINCOTT.

SOUTHWARD from the great Pitti palace in Florence, on the Via Romana, which, like all other roads, leads to Rome, stands a structure whose exterior is but an indifferent exponent of the treasures within. Unlike the palace near at hand, which

rises from cyclopean walls and spreads its wings grandiosely and lifts its vast stories forty feet in height, the structure to which we propose to introduce the reader, is unpromising in the extreme. The eye of architectural taste would appear to have been effectually closed while the façade was reconstructing, and every order and all order ignored. Windows of many forms and proportions have been thrown together as though they were the remnant of the stock of a dealer in old frames, and the singular effect thus produced must be seen to be fully appreciated. The inevitable barred windows in the piana terrena (ground floor) tell a story of former pretension to some dignity if not to opulent elegance, for the structure was once a palace. Though of unprepossessing exterior, this building is to us most interesting and attractive, and we may add, one of the most creditable to the intelligence of Florence, not because of any treasures of art that it holds, but for its treasures of Science, its illustrations of her struggles and triumphs: "The life of nature is better than the dead bones of art."

Over a high portal and carriage entrance, observe an inscription and mark the purpose of this rude building, "R. Museo di fisica e Storia naturale." Behold, we are at the door of the Academy and Museum of the Physical and Natural Sciences, and are ready at once to enter. Within, a wide court open to the sky, appears and lofty gray columns around sustain the heavy walls above.

We find ourselves in an old-time palace, fortunately no longer the abode of opulent imbecility, but devoted to noble purposes. We gaze around: what is that great black globe that stands solemn and alone in yon far corner of the colonnade? Approach! Some remnants of gilding, upon which a few faint lines appear, attest that it was once a terrestrial globe, and displayed, perhaps, all the geographical knowledge of the era which gave it birth. Alas how sadly in eclipse does it now appear. That old globe has revolved upon its axis for three centuries, and owes its origin to Ignazio Danti, a Dominican monk, who made the astronomical instruments still to be seen on the façade of the Church of Maria Novella. It once stood in the Palazzo Vecchio, and having been fingered by thousands, until the boundaries betweeen land and sea were no longer discernible, was passed over to the museum and turned out of doors, happily, perhaps, for the reputation of the geographer of the Grand Duke Cosmo I., whose knowledge of the New World in 1550, must have been rather hazy. It has

ever attests the acceptance of the theory that the earth is a globe, and that men can stand at the antipodes, though we find no Scripture authority for this belief, once esteemed the *unpardonable sin*.

A weather-stained bust of Galileo, green with abundant algæ, stands upon a pedestal at the rear of a court open to the sky, but in the halls above he is honorably enshrined.

Broad easy steps invite us to ascend—but stay! We cannot pass that colossal marble statue whose face bears the impress of questioning thought. We need no name beneath to tell us its significance, the siphon barometer in his hand and his earnest introversion assures us that it is Toricelli reflecting upon the vacuum that bears his worthy name.

Ascend—if you are a naturalist, or love the book of nature and would read her story—you need no further invitation. At the head of the first flight, doors open into the hall of the botanical museum, lecture-room and herbaria, which lie in succession beyond. On the left of the outer door stands a marble bust of Amerigo Vespucci, the appropriateness of whose position we did not discover. In the first hall large glazed cases line the walls, in which are displayed magnificent specimens of fossil palms, calamites, &c. Among these may be named *Phœnicitis vettinoides* from the Tertiary of Vegroni, three feet long; *Flabellaria major* from the Miocene of the same locality; *Latanites gigantea*, *Sassafras ferretianium* from Sinigalia; *Laurus oreodaphnifolia*, all from the Miocene of Italy; *Ficus tetrafolia* from Œningen, Switzerland. A photograph of the fossil *Pinites protolarix*, thirty-six feet in circumference, and now in the botanical garden at Breslau, hangs upon the wall.

Beyond the room we found a collection of natural vegetable products and illustrations of strange tropical and other plants of an extraordinary character, exceedingly interesting and apparently quite as complete as that at Kew. Here were exhibited, readily accessible, giant specimens of *Dicksonia antarctica*, split open to show the peculiar growth of this New Zealand tree-fern; the *Xanthorrhea arborea*, or grass-tree, of Queensland, Australia; *Raphia ruffia* from Madagascar, exhibiting remarkable clusters of obovate, brown, smooth cones from above large scales, leaf-like and singular; *Amorphophallus titanicum* from Sumatra, two feet high and eight inches in diameter, resembling a giant cluster of

ripening dates, an extraordinary product, preserved in spirits; *Macrozamia spiralis* from Melbourne, with its giant rhizoma, and others quite interesting and instructive. Large horizontal cases filled with Fungi in colored plaster, and the minute fungi which attack the vine and the rose, *Oïdium tuckeri*, &c., are represented in wax in gigantic proportions, the work of a master hand. A magnificent illustration of the structure of the flower of a gourd and the process of fecundation of an orchid are also to be seen here, and can be readily studied. These offer admirable subjects for class illustration, while they are attractive to the least scientific. The collection of specimens in these wall cases is rich in Coniferæ, and many of this family from California wore quite a familiar aspect. The wonderful Welwitschia from Africa may be seen among the Gnetaceæ upon these richly-furnished shelves.

On entering the halls, or saloons, containing the herbaria, my eyes first fell upon Loganiaceæ, named in honor of James Logan, of Philadelphia, the faithful friend and confidential agent of William Penn, one of the most learned men of his day and author of a treatise on the sexual character of *Zea mays* (Indian corn). This treatise (*Experimenta et Meletemata circa Plantarum Generationem*, 1739) was so far in advance of the age as to be rejected by the Philosophical Society of London, but having been printed by Dr. John Fothergill, at Leyden, it was admitted to be of great value to botanical science, which had not yet accepted the doctrine of the sexuality of plants.

With kind courtesy I was conducted by Professor Theodore Caruel, the learned director of the botanical department, through the great halls devoted to the preservation of the herbaria. These collections much exceeded my expectation, and the manner in which they are arranged should serve as a model for imitation by similar institutions. On shelves around the walls of the two large saloons, the fasciculi containing the dried plants are arranged in natural orders, and so classified that in a few minutes any specimen can be found; each is attached to its label, which is pinned to a sheet of stiff paper so that the plant can be examined and studied without detachment from its definitely ascertained name. The number of species here arranged is not yet known, since the collection is in process of reëxamination and enumeration by Professor Caruel. Here may be seen those presented to the museum by

Philip Barker Webb. This botanist had traveled extensively over a large portion of Europe and Asia Minor, accompanied by Berthollet, and together they published a volume on the Canary islands, where he had for several years resided. Having visited Florence, in 1848, he was so much impressed with the value of its botanical collection, and with the interest in the museum shown by the Grand Duke, that he bequeathed his rare herbarium to the prince, and endowed the botanical section with an annual income to aid in its extension. His botanical library of 5000 volumes is fitly arranged in an adjoining room, and ranges from Theophrastus to Gray, through Bauhin and Miller and the bulky Herbals, and long lines of the *Botanical Magazine* and many other serials. I was glad to see that several recent volumes of the AMERICAN NATURALIST, handsomely bound, had been added to the collection.

The herbarium of Webb is said to have contained eighty thousand specimens. What tales they could tell of wanderings in the far-away wilds in which they grew, of weary travel amidst deserts, forests, swamps and on Alpine heights, by enthusiasts prompted by the genius of science. None but the devotee to botanical research or the mania for collecting, can know the joys of the discoverer of unknown plants. To find a species hitherto undescribed, or better still, the representative of a new genus, with the faint hope that some light of botany may recognize his devotion and immortalize him by giving his obscure name thereto, thrills him with a joy unknown to common mortals. Webb is fittingly commemorated in a marble bust placed in the full light of a window, in the hall devoted to the display of vegetable products, and again on canvas in the gallery of his unique library. In the latter he is represented as a ruddy Englishman of honest, kindly, beaming countenance that glows with the enthusiasm that might have sat thereon while regarding for the first time some hitherto unknown plant in full flower.

Here I had the pleasure of looking through the oldest known herbarium,[1] that of André Cæsalpini, which, according to the

[1] This is the oldest known herbarium, unless the recently discovered garland on the mummy of Amenohotep I, be regarded in the character of a "hortus siccus." These garlands are, for the most part, in as perfect preservation as if in a herbarium. Among these ancient Egyptian plants, *Delphinium orientalis*, *Nymphæa cærulea*, *Nymphæa lotus* and *Carthamus tinctorius* have been satisfactorily determined from the petals and sepals which were found arranged in rows and attached to willow

dedication in his own handwriting, to his patron, Bishop Tournabuoni, was made in Pisa in 1563. This herbarium has been bound in three thick folio volumes, and contains 767 specimens of plants. One of them, however, proves to be a zoöphyte (Sertularia). No attempt at classification appears therein. Greek and Latin names are appended to many of the specimens, which are generally well preserved, though a few have disappeared. This herbarium has been ably described and catalogued by Professor Theodore Caruel, the learned director of the botanical department, in his work entitled, "Theodori Caruelii, Illustratio in Hortum Siccum Andreæ Caesalpini. Florentiæ, MDCCCLVIII." His dedication of this volume to his father's memory breathes so grateful a sense of filial regard, and is withal so beautiful, that we cannot refrain from presenting it to the reader. May it influence other parents to encourage their sons to pursue the noble paths of natural science, and thereby save many a youth from the snares that beset adolescense: "Tuo nomini tuæque memoriæ Constans Theodore Caruel, parens optime venerande cujus potissimum consensu et ope naturalium disciplinarum studia ab ipsa adolescentia excolui, primum huncce laborum meorum fructum pio gratoque animo volens libens inscribo."

In the cabinet which contains the precious herbarium above referred to, stand also upwards of sixty large folio volumes bound in parchment, a mode much in favor in Italy. These are the manuscripts, &c., of Micheli, many of which have not been edited. To this botanist we owe the discovery that Fungi are truly vegetable organizations, and several colored drawings of these plants may be seen in his herbarium. As he lived during the first thir-

leaves (*Salix salsaf*) by means of thread of the date-leaf, the whole forming a garland. The dried fruit and yellow blossoms of *Acacia nilotica* were also found, and on some of the other mummies fine detached specimens of blue and white lotus with stem, blossom and seed-pods complete. Upon another was found a lichen (*Parmelia furfuracea*), a plant indigenous to the islands of the Greek archipelago and which must have been brought to Egypt B. C. 1100 or B. C. 1200. It is still used by the native druggists at this day.

These frail relics of the past have been arranged for the Boolak Museum, classified, mounted and illustrated by modern examples of the same flowers and plants and fill eleven cases—an unique collection. The hues of these old-world flowers are said to be as brilliant as those of their modern illustrators, and were it not that the tables show them to be 3000 years apart, no ordinary observer could distinguish between those buried with the Pharaohs and those gathered and dried but a few seasons since.

ty-seven years of the eighteenth century, he was a precursor of Linnæus. Busts in marble of the elder De Candolle and of Micheli adorn this cabinet—the first of massive feature, the latter keen of aspect with his aquiline nose and cowled brow.

In addition to Webb's vast collection there may here be seen the plants of Pavon from Chili and Peru, those collected by Labilliardiere, who accompanied La Perouse to New Holland, and of Desfontaines and Mercier in Tunis and Algeria. Labilliardiere having been taken prisoner by the Dutch and his collection brought to England, it was, through the generous intervention of Sir Joseph Banks, restored unopened, "lest," as Sir Joseph wrote to Jussieu, "a single botanical thought should be taken from him who had gained them at the expense of his own life." Noble Sir Joseph!

The Florentine museum is rich in fossil plants, some of which, it is said, are not represented in other cabinets of Europe. Among the 4000 valuable specimens the more noteworthy are from the Carboniferous near Volterra, and fossils from Sinigaglia, the Miocene of Tuscany and the Permian of the Brescian territory and a splendid collection of palms from Verona and Vicenza, and impressions of plants from the lava of Lipari. A great collection from the Miocene of Switzerland, illustrated by Dr. Heer, is also exhibited conspicuously.

One of the early and earnest co-laborers in the department of science, was Dr. Targione Tozzetti,[1] grandfather of the present distinguished Professor Targione, director of the invertebrate section of this museum. At the age of twenty-three he was appointed professor of botany under Micheli at Pisa, and afterwards director of the botanical gardens at Florence. He was also librarian of the Magliabecchian library, and arranged the vast number of volumes bequeathed to the city by the eccentric collector and wonderful linguist whose name it bears. Dr. Targione Tozzetti traveled through Tuscany collecting materials for his great work on the agriculture, natural history, art and antiquities of his native country, but the more important work of this man of encyclopædic mind, was his last, on the Progress of Physical Science.

In the botanical museum Professor Parlatore, the late director

[1] Professor Targione Tozetti and Micheli have received fitting commemoration in Santa Croce, the Westminster Abbey of Florence.

of the botanical department, is commemorated in marble, and stands in friendly opposition to the generous enthusiast Webb.

A walk through the botanical gardens and greenhouse proved very interesting ; the former especially, since it served to indicate the character of the winters that have permitted *Chæmerops humilis* to grow thirty feet high in the open air, grand clumps of *Nerium oleander* to flourish unscathed, and giant *Lagerstræmia indica*, rivaling our quince trees in size, to exist without protection Pampas grass also endures the winters here unguarded from snows and cold. The Botanical gardens adjoin the Boboli garden of the Pitti palace, but are not generally open to the strolling visitor. A much larger space has recently been devoted to the construction of new gardens for the scientific arrangement and study of plants, which lies near the "Institute for higher studies" on the Piazzo San Marco. The street upon which it opens is appropriately named Via Micheli.

Passing for the present the grand Tribune of Galileo, which is entered at the western end of the corridor, the middle door of which has given us access to the Botanical hall, let us ascend to the second piana (the third story of the American). Before us, over the entrance to a series of rooms, we read, "Regno Animale," and observe on the right a marble bust of Fontana, the early scientific projector and arranger of this museum, and on the left a bust of Leopold I., the then reigning Grand Duke of Tuscany, whose warm interest in science made him its liberal patron. A wide doorway invites, through which we discern others opening between successive minor departments, whose walls are covered with glazed cases, in which are exhibited a large collection of objects of scientific interest. We enter unchallenged by the guard, and are within a small room devoted to zoöphytes, and find ourselves at the base of the scheme of animal existence, or at that section of it that can be illustrated by mural specimens for popular instruction.

Having entered, we quietly soliloquize—here we have found a museum in which some presiding mind has guided the exhibition of the myriad objects that compose it. "Has any seen the mighty chain of being, lessening down from Infinite Perfection to the brink of dreary nothing—desolate abyss?" has often run through my memory, and never before did I imagine I had come so near to finding an answer to my query. As we pass onward

insects, and some of their products appear, among which we notice the remarkable web of the *Tinea granella*, or granary moth, which most resembles a sheet of white tissue paper, two feet high and one foot in width. Enormous crustaceans, spiders, &c., may next be seen, all brought so near to the observer that he can study them readily. We soon find that we are following a *linear* arrangement, a system of classification which modern research and wider philosophy have shown is but an imperfect illustration of the thought of the Creator.

Many learned naturalists have labored at the construction of systems of classification, but each succeeding scheme has given way before increasing knowledge of the relations of groups. Whether we suppose relations represented in a linear arrangement or in a circular one, in which circle touches circle within circle, or as a sphere in which is contained a multitude of minor spheres representing classes, groups or genera touching on many sides—all have proved artificial, all have failed to reflect the facts of nature, as later insight has proved them to be mutually related. The *key* to the cause of the multiplex relations of animal forms not having been found, every effort to present them aright could but prove unsuccessful. Recent discoveries in embryology and palæontology, having thrown a flood of light upon the intricacies of this question, by their wonderful illustration of the doctrine of development *arrested* and *accelerated;* the *key* to a correct system of classification in the vegetable and animal world, it is believed has at length been placed in our hands.

The study of living forms alone cannot guide us to the construction of a system that shall explain the relations of genera in the animal and vegetable worlds. As the relation between the living men and women of this generation can only be satisfactorily illustrated by tracing their respective genealogies back to some common ancestry, from which they have derived their similarity of physique, physiognomy or mental traits, and their minor diversities, so we must discover and study the originals which gave rise to the multiform representatives of ages of development therefrom, as found in the genera and families in the world of nature at large. Palæontology, therefore, becomes a guide to the determination of the order of successive forms through which the predecessors of the living plants and animals have passed. A more profound acquaintance with those ancient forms, and with

the changes through which they have passed, is demanded before a system can be made, perfectly adapted to the illustration of the infinite modifications of the living. How widely has expanded the range of the science that was once thought only worthy of triflers and silly enthusiasts! It has become co-extensive with the origin and destiny of all things, its limits are time, its range the universe; its philosophy, all-comprehensive, is bound up with human progress and human destiny.

But we will not longer detain the visitor anxious to advance. From enormous crustaceans we proceed directly to mammifers and the skeletons of birds, &c. Not such is the order of nature we observe, and retire upon our philosophy to wait until evolution shall have prepared for us the system that will show us how from the lower forms sprang fishes, from fishes reptiles, from reptiles birds, and how from batrachians were produced higher forms, culminating in mammifers and eventually in bimana and hence man. We gladly acknowledge that an outline of this system has been effectively foreshadowed.

In a large room the birds, ever pleasing, are displayed to advantage, not being crowded into limited space, as is our unrivaled collection in the "Academy of Natural Sciences" in Philadelphia. In another section Dr. Enrico Hillyer Giglioli, professor of zoölogy in the "Royal Institute for Superior Studies," and director of the Museum of Zoölogy, has prepared and arranged in a suite of noble saloons, a nearly complete exhibition of the fauna of Italy. This is the first of its kind for an entire kingdom that I have seen, and I found it a very striking and rich treat.[1]

[1] This grand central collection of Italian vertebrates contains, at the present date (May, 1883), 22,331 specimens of 1139 species of Italian animals. Of these there are 1500 mammals representing 108 species, and the collection is pronounced complete. There are 2200 specimens of birds representing 415 species, which nearly complete the series. Reptiles number 2754 specimens of forty-one species, which complete the series found in Italy. Of Amphibia there are 1830 specimens of twenty-one species, and this number includes every known species in the kingdom. Finally, there are the vast number of 14,048 specimens of fish, representing a collection of 554 species, which is pronounced nearly complete.

To Professor E. H. Giglioli we are indebted for the discovery of an ocean fauna in the Mediterranean. It was during his researches in the steamer *Washington*, a government vessel commissioned for deep-sea dredging, placed at his disposal, that he made the important discovery above stated in August, 1878. His announcement of this discovery appeared in *Nature* of 25 Aug. of that year, and his report was published in the "Acts of the Third International Geographical Congress," Vol. II. Venice, 1881.

Professor Giglioli is a genial gentleman of English and Italian parentage, and his language proves that he learned it at his mother's knee. His collection is worthy of the highest commendation, and his success should stimulate other kingdoms and peoples to emulate the example of Italy. To the generous kindness of Professor Giglioli I must acknowledge my indebtedness for many courtesies.

The anatomical preparations in this museum are interesting and of extraordinary character, unrivaled elsewhere. The art of preparing waxen models so that they can scarcely be distinguished from natural objects was brought to perfection by a Sicilian noble of Syracuse, named Zumbo, who was born in 1656. The report of his wonderful skill having reached the Grand Duke Cosmo III., Zumbo was invited to Florence. He afterwards left Tuscany for Marseilles, where he was patronized by Louis XIV., and died in 1703.

The waxen preparations exhibiting the internal structure of the Torpedo, are wonderfully life-like, having the appearance of real flesh. They illustrate the experiments made by Tain and Matteucci in animal electricity. Here are also magnified illustrations of the anatomy of the lobster, cuttle-fish, earth-worm and tongues of mollusks, the latter in gigantic enlargement. Also the internal anatomy of the silk-worm, of the domestic cat, goat, rabbit, cod-fish, and the several stages of the development of the chick from the egg of a hen, through the twenty-one days of incubation. The muscular fibers and tracheæ of a common fly are magnified 900 diameters or 729 million times in volume. This exhibit is one of the most remarkable evidences of the transcendent skill of the artist.

In adjoining rooms are displayed, of life size, a multitude of illustrations of human anatomy. In one, the arteries of the entire frame are represented in true color, form and place, standing out alone; and in another the veins appear by themselves, while in a third the arteries and veins are seen with all their intimate inter-osculations. In a fourth the observer is introduced to his nervous system, and its wonderful net-work of white cords is seen interlacing and enveloping the entire anatomy of veins, arteries, bones and muscle, the skin alone having been removed. Every stage of dissection is illustrated, every organ is represented, from the hair to the toe-nails, and the visitor might for a moment imagine him-

self transferred to the midst of a dissecting-room with all its ghastly surroundings. His consciousness that these animal forms and repelling developments are but waxen models, preserves him from losing his equilibrium, or he would be prompted to flee in horror from the scene. The sickening exhibition of several stages of the progress of the plague, that once disgraced this series with its disgusting details, with other preparations, thanks to an awakened sense of propriety, have been removed to a private room.

The value of these models can scarcely be deemed commensurate with the expense incurred in their preparation. Many, however, who would not enter a dissecting room, who could not contemplate the real organization, may here learn much respecting their internal economy—learn that they are "fearfully and wonderfully made." It cannot be of equal service to him who would know the inner workings of the human machinery, since he can be satisfied only by the dissection of the structure once endowed with life. It were better to limit their examination to the select few, rather than expose them to the gaze of the frivolous and debased.

The palæontological collection was formed by order of the government from material already in the museum, with additions made thereto in answer to resolutions passed by the third Scientific Congress held at Florence, which recognized its value and recommended the enlargement by an exhibition of representative minerals and geological specimens from all parts of Italy. The collection having outgrown the limits of the museum on the Via Romana, was removed to extensive rooms on Piazza San Marco, where also is located the "Royal Institute for Higher Studies," established since the accession of Victor Emmanuel in 1861. Chairs of geology, metallurgy and mining were then established, under the charge of competent professors, for a new life has been breathed into Italy.

This museum abounds in fossil mammals from the valley of the Upper Arno, and has also numerous fossils from the Cretaceous. Some of the elephants are truly colossal, rivaling the mightiest mastodon of North America, specimens of which also are here exhibited.

Elephants must have abounded in the upper valleys, and the abundant remains of this species and of rhinoceros, hippopotamus, found in a deposit that probably once formed the bottom of

a fresh-water lake, indicate that their carcases were washed there by the flowing waters, and sank eventually to its bottom. The mammals of this section have been studied by Dr. Falconer, who has published numerous observations thereon. Among the more interesting may be named *Elephas meridionalis* (Nesti), *Rhinoceros etruscus* (Falconer), *R. megarhinus* (Christolf), *Hippopotamus major* (Cuvier), *Bos etruscus* (Falconer), *Equus stenonis* (Cocchi), *Cervus dicranios* (Nesti), *C. ctinoides* (Nesti), and *Bos primigenius* (Blum.).

This museum has known its seasons of struggle with adverse circumstances, connected with the rise and fall of rulers during the latter part of the last and early in this century, and was not placed upon a firm foundation until the establishment of Victor Emmanuel upon the throne of Italy in 1861.

Credit is due the Grand Duke Leopold of Tuscany, who employed Fontaina to collect objects illustrative of natural history, purchased the palace of the Bini and opened the museum to the public in 1780. During the days of Bonaparte ascendency, the new Queen of Etruria added a school of "public instruction" and founded chairs in astronomy, physics, anatomy, zoölogy, mineralogy, botany and chemistry, which was maintained for seven years, until the downfall of the Napoleonic kingdom and restoration of the Grand Duke, when the school was suppressed. Nearly twenty years passed, and it was revived, and again at the accession of Victor Emmanuel, when the institution for more advanced studies was founded, and chairs of geology, metallurgy and mining were added, and courses of lectures annually delivered.

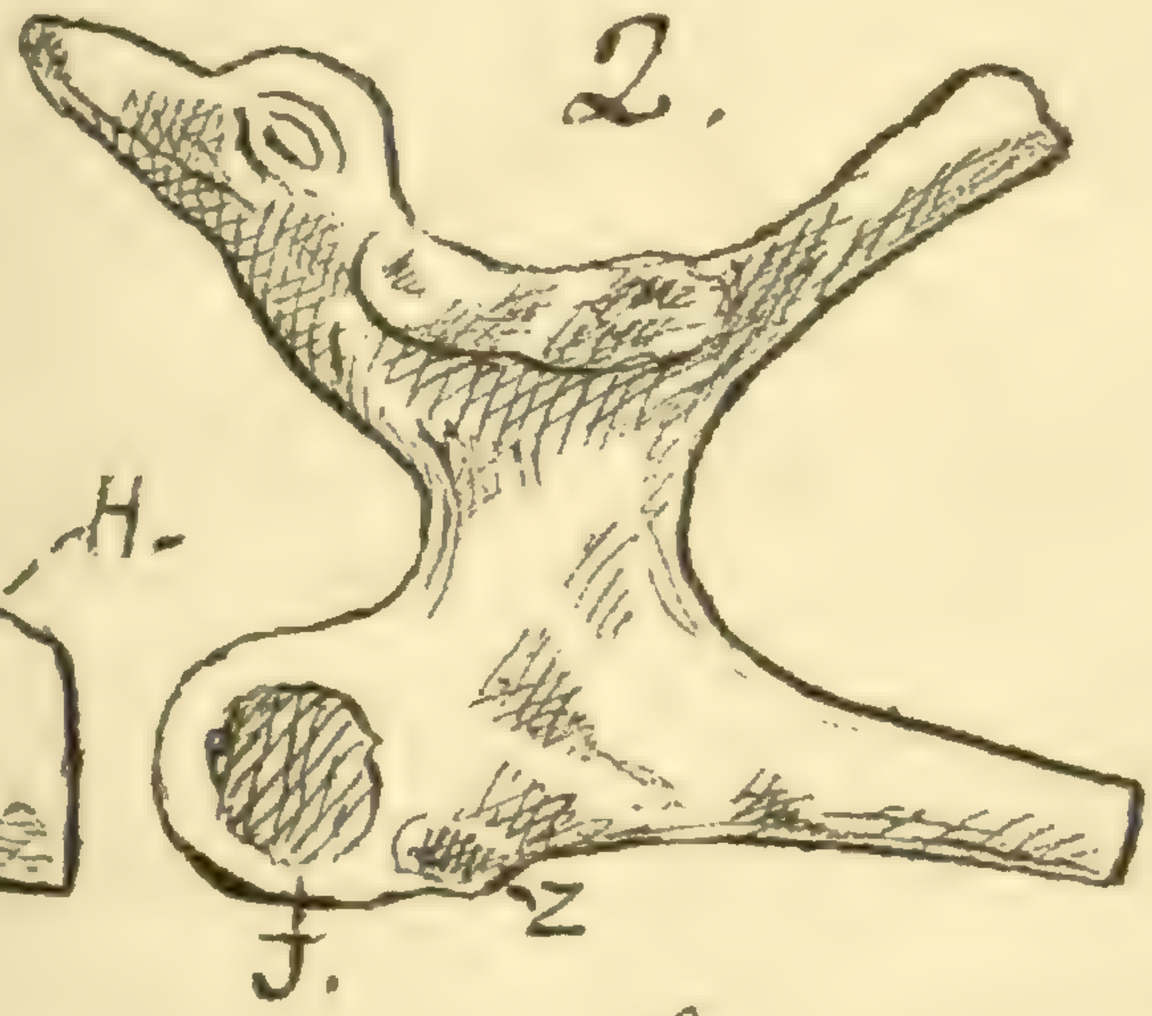
The shackles of spiritual tyranny having been unbound and the equally hard bands of classical devotion loosed, Italy has at length let in the light her unwise rulers sought to hide, and a new life is stirring in the veins of her children. If true to herself, and in the employment of her opportunities, if earnest in efforts for wider culture, and wise in her choice of science as the intellectual trainer of the growing mind, and if open to the reception of a sound Christian faith, attended by a corresponding advance in her moral sense, she may happily take again the place she once had as the first among the nations.

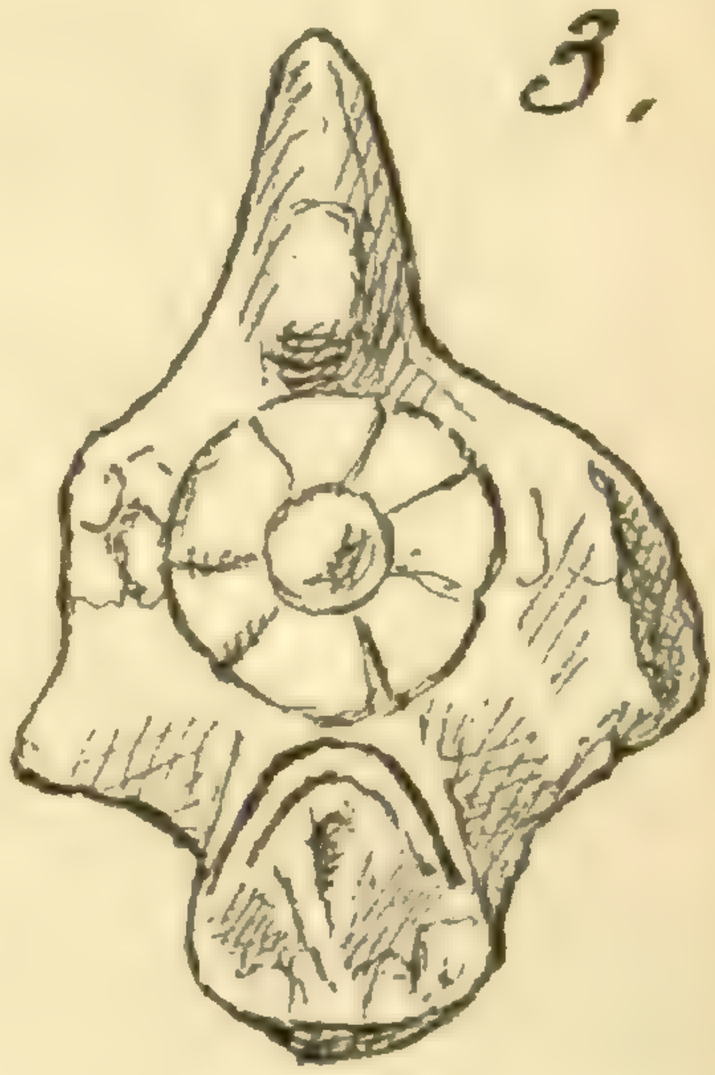
CONSTRUCTION OF ANCIENT MEXICAN TERRA-COTTA PITCH-PIPES AND FLAGEOLETS.

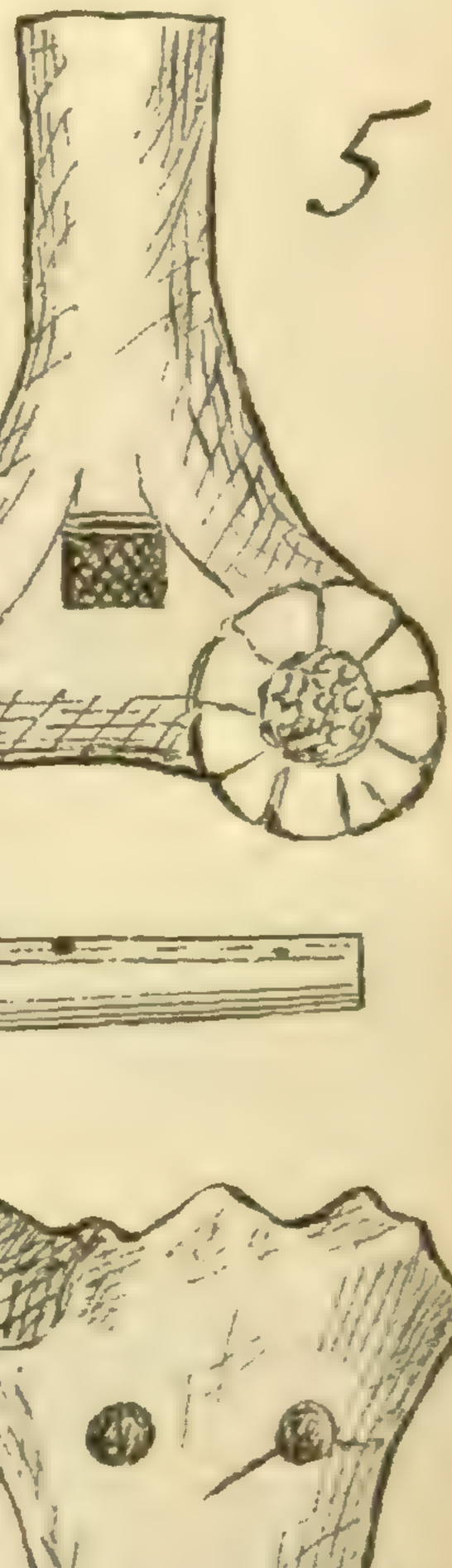
BY H. T. CRESSON.

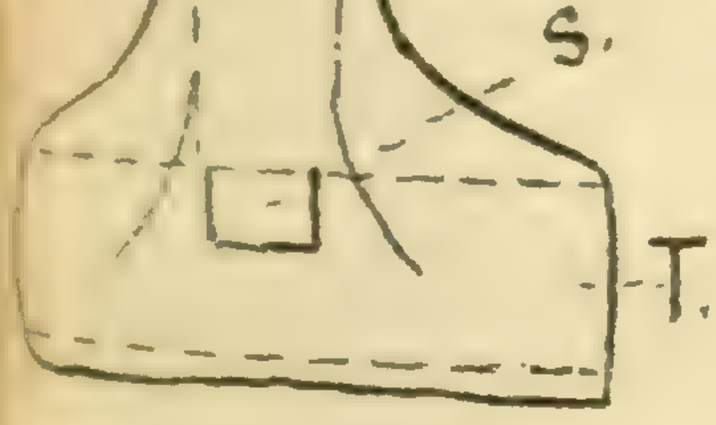
THE smooth internal structure of the pitch-pipes[1] and flageolets of baked clay, or terra-cotta, manufactured by the ancient Mexican potters, suggest that they have been modeled upon forms of some material capable of receiving a high degree of polish, probably bone or wood. The pitch-pipes shown in Figs. 2–5 (Plate XVI) have been made in this way, and are the most ingenious specimens of aboriginal plastic art in the collection of musical and other Mexican antiquities made by the Honorable J. R. Poinsett, United States Minister to Mexico in 1830. Figs. 1 and 2 (Plate XVI) are the front and profile views of a pitch-pipe, which is more primitive in style of construction than those shown in Figs. 1, 3, 5, 6 (Plate XVII), hereinafter described. An analysis of its construction shows that it has been made in three parts, viz., a clay reed, Figs. 1, R, 4, R (Plate XVI), a neck-piece or flap, Fig. 10 (Plate XVI), and a body, Fig. 4, T. A careful piece of workmanship is shown in the modeling of the first-named portion, or clay reed, Fig. 4, R, by means of which the air from the lungs of the performer is conveyed into the sound hole, Fig. 4, S, thus communicating with the body of the instrument, Fig. 4, T. This part measures one and three-quarter inches in length, by half an inch in width at its broadest portion (mouth-piece), gradually contracting as it approaches the sound-hole, Fig. 4, S, to about six-sixteenths of an inch. These measurements have been made from thirteen different clay reeds, and in the average, vary but little from one another. A section made through a neck-piece, parallel to the opening of the air passage, shows that the form upon which the clay reeds, Figs. 1, R, 4, R (Plate XVI) were modeled, had the shape of a thin, elongated wedge, an outline of which is given by the dotted lines in Fig. 4, R. The flaps, Fig. 10, F, were then cut out of clay rolled thin,

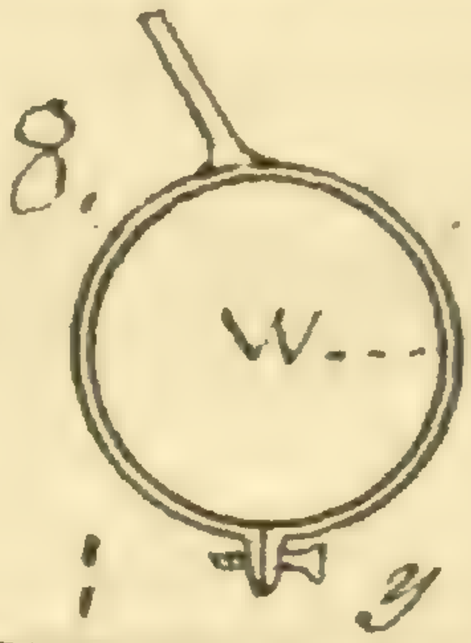
[1] As the instruments which are denominated pitch-pipes have heretofore generally been called whistles, it will be necessary to state that since the discovery of their musical powers (most of the retort-shaped pipes in the Poinsett collection possess stop-holes which, when closed, change the pitch of their respective instruments), it will be impossible to class them as such. The name pitch-pipe has, therefore, been adopted. See "Musical Instruments in the South Kensington Museum," by Carl Engel, page 285. (1385–'64.)

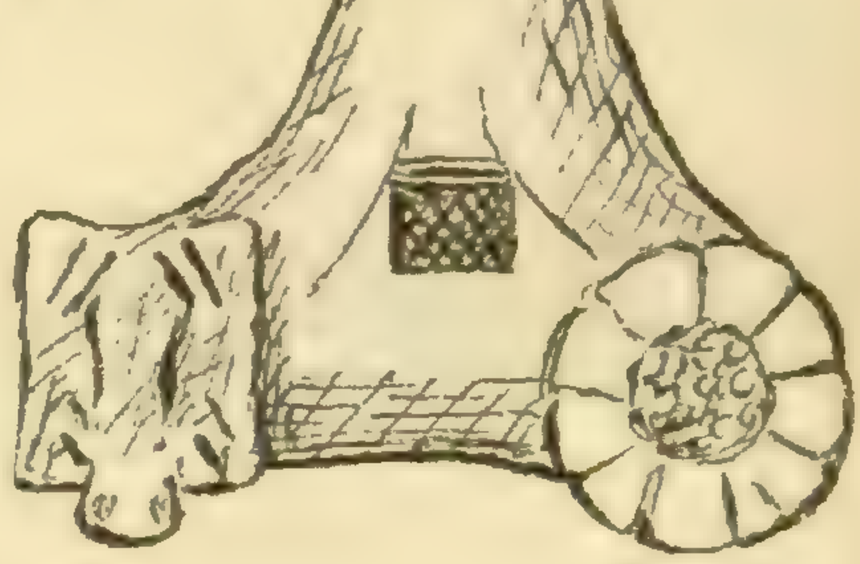


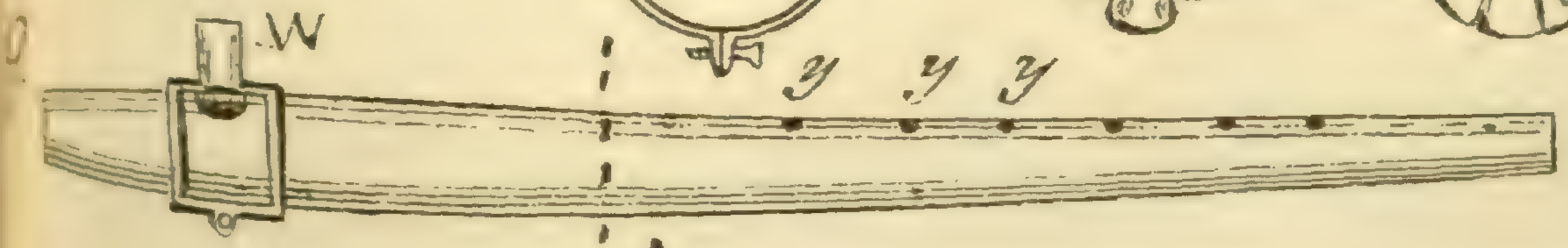


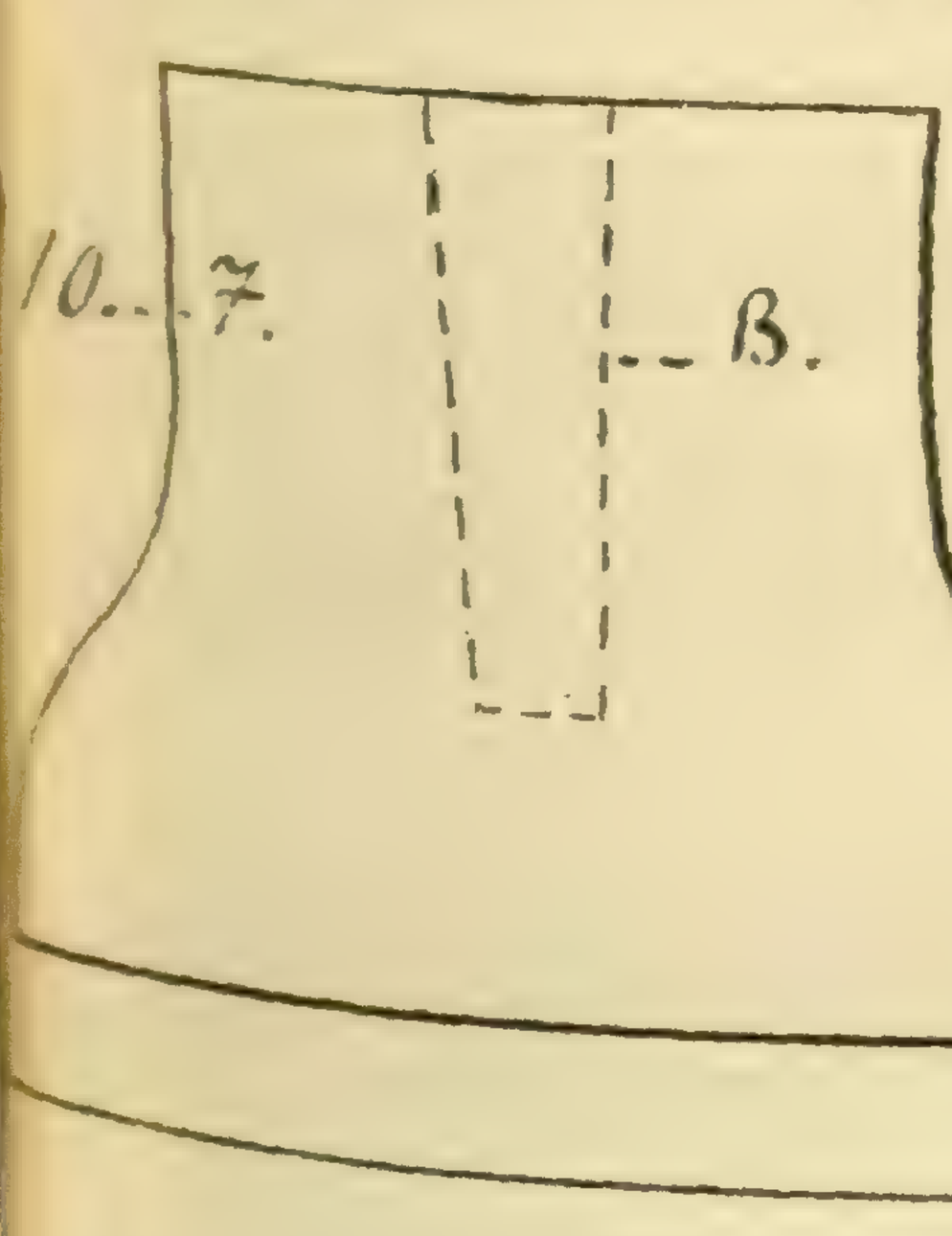


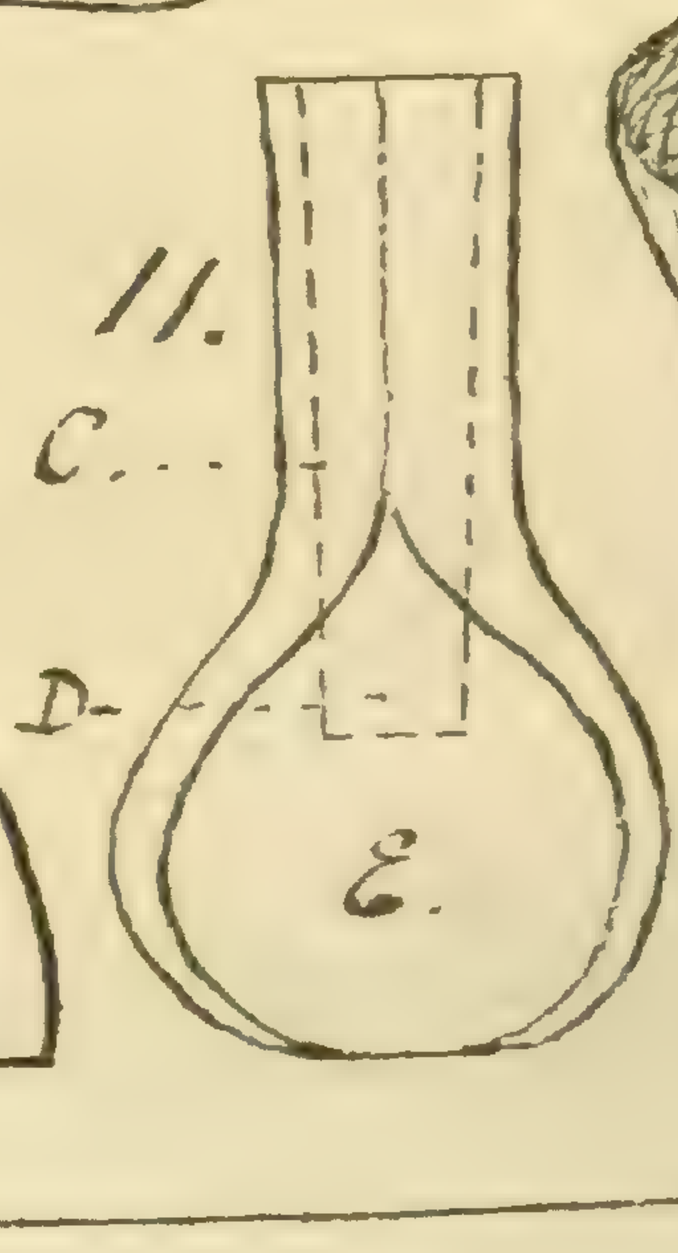


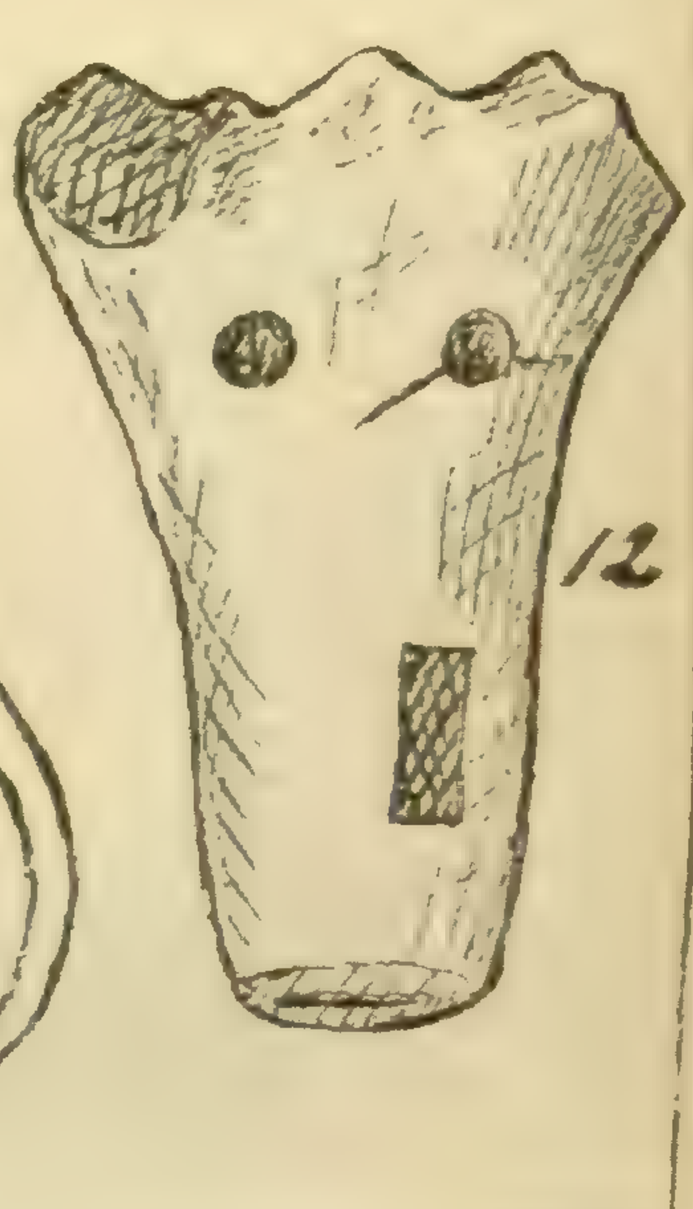












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similar in shape to the outline shown in Fig. 10, and the clay reed, Fig. 10 B, enveloped therein. The dotted lines in Fig. 11 C, represent the clay reed, Figs. 1 and 4 R (Plate XVI), after the flap Fig. 10 F, has been modeled around it. This, it will be seen, divides into two portions a little distance above the narrow end of the reed, Fig. 11 D, which overlies the sound-hole upon the body portion, Fig. 4 S, running to either side and protruding beyond its terminal portion about two and a-half inches. This forms the notch into which the body of the pitch-pipe is introduced, Fig. 11 E (Plate XVI). A view of a section of the clay reed, made parallel to its aperture, Fig. 13 (Plate XVI), shows the exact size and shape of the air-passage. Specimens of these instruments, which have been detached in sections, suggest that this covering of the clay reed by the flap, Figs. 10, F and 11, C,[1] was accomplished while the reed was in a semi-dry condition. In order to understand the method pursued in joining earthenwares that have been made in pieces, it will be necessary to consider briefly the processes of our modern potters. Fictile wares, modeled upon the wheel or lathe, at a certain stage of the drying process possess a greater tenacity than at any other time, until they are baked—this is called by potters the green, or semi-dry state. While in this condition they are attached to the lathe by a little moisture, and turned nicely into the proper shape. This same degree of dryness, which admits of the clay being turned on the lathe, serves for attaching the handles or other appendages to earthen vessels. The parts to be attached, having been prepared, are joined together by means of liquid clay (called slip, by the potters), and the seams having been smoothed off and finished by careful modeling, are then ready for the kiln, which is to convert the tender clay into the hard biscuit. Having thus explained the way of making jointures while the clay is in semi-dry condition, it may be inferred, as the process of the ancient Mexicans did not in all probability differ essentially from those used by our modern potters, either in material or other methods of manufacture, excepting of course the use of the lathe, that these old potters used the semi-dry state to cover the clay reed with the clay flap, in order to avoid compressing the air-passage (which is very narrow, see Fig. 13, Plate XVI, where exact size thereof is given), at the

[1] The dotted lines in Fig. 11 C (Plate XVI) show the outline of the clay reed when covered with the protruding end thereof, Fig. 10 D (Plate XVI).

same time, allowing the form to be withdrawn before the clay reed had become hard and brittle. A section of the body portion of a pitch-pipe, like Fig. 4, R, T (Plate XVI), shows the shape of its interior, indicating the use of a cylindrical form, about inches in length, upon which this portion, one and three-e inches long, was modeled. One end of the barrel is close stopper of clay, the other remaining open.[1] The caref noticeable in the interior of all these musical instrument striking contrast (especially in the more primitive speci 1, 2, 5), when compared with the rough modeling of t' portions; this would be absolutely necessary, as any i.. therein would interfere with the accuracy and quality of the .. s emitted. A decided advance in the construction of primitive musical instruments was made by the ancient Mexicans beyond the simple tube or whistle, when their artisans produced such forms as Nos. 1, 2, 5 (Plate XVI). Take, for example, some of the primitive forms of whistles without finger holes, exhibited in the collections of the Smithsonian and Peabody museums, Figs. 6 and 7 (Plate XVI), which have already been described by Dr. C. C. Abbott in the United States Geographical Surveys west of the 100th meridian, p. 235 (illustrations Nos. 115, 116, 119 of that work). These, when applied to the lips and a current of air was impelled therein from the lungs of the performer, were no doubt (while in a perfect condition) capable of producing certain shrill notes. Blowing through a very small aperture of the lips against the edge or orifice of the sound-hole, thus directing the wind chiefly within the tube, naturally requires more practice in order to produce different notes. An invention was devised by the ancient Mexicans to overcome this difficulty of labial manipulation, by means of which the sounds were made even and regular, and were easily produced. The modern fife is sometimes furnished with a mouth-piece similar to that shown in Figs. 8–9, W (Plate XVI), which directs the current of air from the lungs of the performer, thus requiring less skill and labor to produce the requisite volume of sound. It will be seen that this mouth-piece, Fig. 9, W (Plate XVI), used upon the fife, is similar to that portion of the pitch-pipe which has been denominated the neck-piece, and is

[1] When the pitch-pipe is blown into, by stopping the aperture of the barrel with the finger, a note one-fourth lower than that given while open, is produced. See Proceedings of the Academy of Natural Sciences of Philadelphia for 1883, p. 80 Aztec Music.)

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attached to the body portion of the terra-cotta pipe, shown in Fig. 4, T, by means of the notch formed by the clay flap in enveloping the clay reed, Fig. 11, E[1] (Plate XVI). A good illustration of this can be made by attaching a metal mouth-piece to one of our modern fifes, Fig. 9 (Plate XVI), and then sawing it asunder between the sound-hole, Fig. 9, W, and the finger perforations, Fig. 9, Y, Y (shown by the dotted lines). This having been done the result would be an instrument similar to Figs. 1 and 4 (Plate XVI).[2]

A pitch-pipe, showing an advance in construction upon that already described, resembling somewhat a retort in form, is shown in Figs. 1–3 (Plate XVII). It is modeled in four pieces, and the clay reed has been made in the same manner as those upon the sections shown in Figs. 10 and 11 (Plate XVI), differing only in the form of the body, which is circular. In order to accomplish the modeling of the body portion, it would be necessary to use a circular form, dividing it into two portions, Fig. 2 (Plate XVII), one half being modeled on one portion, Figs. 2, R (Plate XVII), and the other half upon the other side, Figs. 2, S (Plate XVII). The two halves being made so as to correspond nicely when joined together. The double pitch-pipe, shown in Fig. 4 (Plate XVII) demonstrates that this method was pursued, from the fact that while in the kiln the two halves which compose the body have been separated by the action of the heat, thus showing its construction. By careful examination traces of this jointure can be seen in some of the pitch-pipes, although in most cases it is impossible to detect it, so nicely have the marks of jointure been concealed by skillful modelings. Each one of the retort-shaped instruments, Figs. 1–3 (Plate XVII) is pierced by a stop-hole,[3] Fig. 3, A (Plate XVII), which is placed to the left hand side of a line drawn longitudinally around the body of the pipe, passing through the center of the sound-hole (holding the neck-piece toward the

[1] The fact must not be overlooked that the clay reed is enveloped by the clay flap, these two parts constituting the neck-piece.

[2] The clay reed, Fig. 1, R (Plate XVI) attached to the body of the ancient Mexican pitch-pipes of terra-cotta, Figs. 1 and 2 (Plate XVI), by means of the clay flap, Fig. 10 F (Plate XVI), resembling the mouth-piece of our modern fife, shown in Fig. 9 W, is therefore an invention of our North American aborigines.

[3] When the stop-holes are left open in the right-angled and retort-shaped pipes, Fig. 1, R (Plate XVI) and 1–3 (Plate XVII); if the instruments are blown into, notes one-fourth above those given when closed are obtained in all the pipes excepting the No. 8 or octave pipe, which gives the interval of a fifth.

performer. Underneath the retort-shaped pitch-pipes, close to where the neck-flap and body are joined together, Fig. 1, B (Plate XVII), there is generally a button of clay, pierced by a hole through which a cord might be passed, forming a loop for suspension, or to attach it to the body of the musician. The primitive pipes shown in Figs. 1 and 5 (Plate XVI) do not have the button attached, but are pierced by a hole, used for a like purpose, made through the thick part of the neck-piece, Fig. 2, Z (Plate XVI), near to its jointure with the body.

A large pitch-pipe, Figs. 5–6 (Plate XVII), the character and outline of which are admirably shown by the artist, has been found among the specimens of the Poinsett collection since the publication of an article upon Aztec music by the Academy of Natural Sciences of Philadelphia. The instrument in question, Figs. 5–6, is pitched in the scale of A (three sharps compared with the flute), and the construction of the neck-piece and other parts differs but slightly from those already described. The body portion, Fig. 5, C and 6, D (Plate XVII), is considerably elongated and well adapted to produce the rich, mellow sound which it emits when blown into. Traces of jointure in this specimen are admirably concealed, and demonstrate that the body of the instrument was made in two pieces (upon a form) similar to that shown in Fig. 7, R, S (Plate XVII), although much more elongated. The body is pierced by a stop-hole, Figs. 5, E and 6, F (Plate XVII), like other pipes, and may be classed, on account of its construction and the grotesque decoration of its exterior, with those of retort-like form, shown in Figs. 1–3 (Plate XVII).

The construction of the Aztec pitch-pipes in the Poinsett collection of antiquities having been described, it will be necessary to say a few words upon their progression from primitive instruments, which it may, in all reason, be assumed were produced as among other barbarian nations, while their ancestors were in a savage state. As shells pierced by sound holes, and hollow tubes of bone or cane (without finger holes) were in all probability the most primitive instruments manufactured and used by the ancestors of the Aztecs, it may readily be granted that these, however rude when first invented, gradually improved as they advanced toward the middle status of barbarism. The primitive whistles already mentioned, Figs. 6, H, 7, H (Plate XVI), which were exhumed from the graves of the savage tribes who inhab-

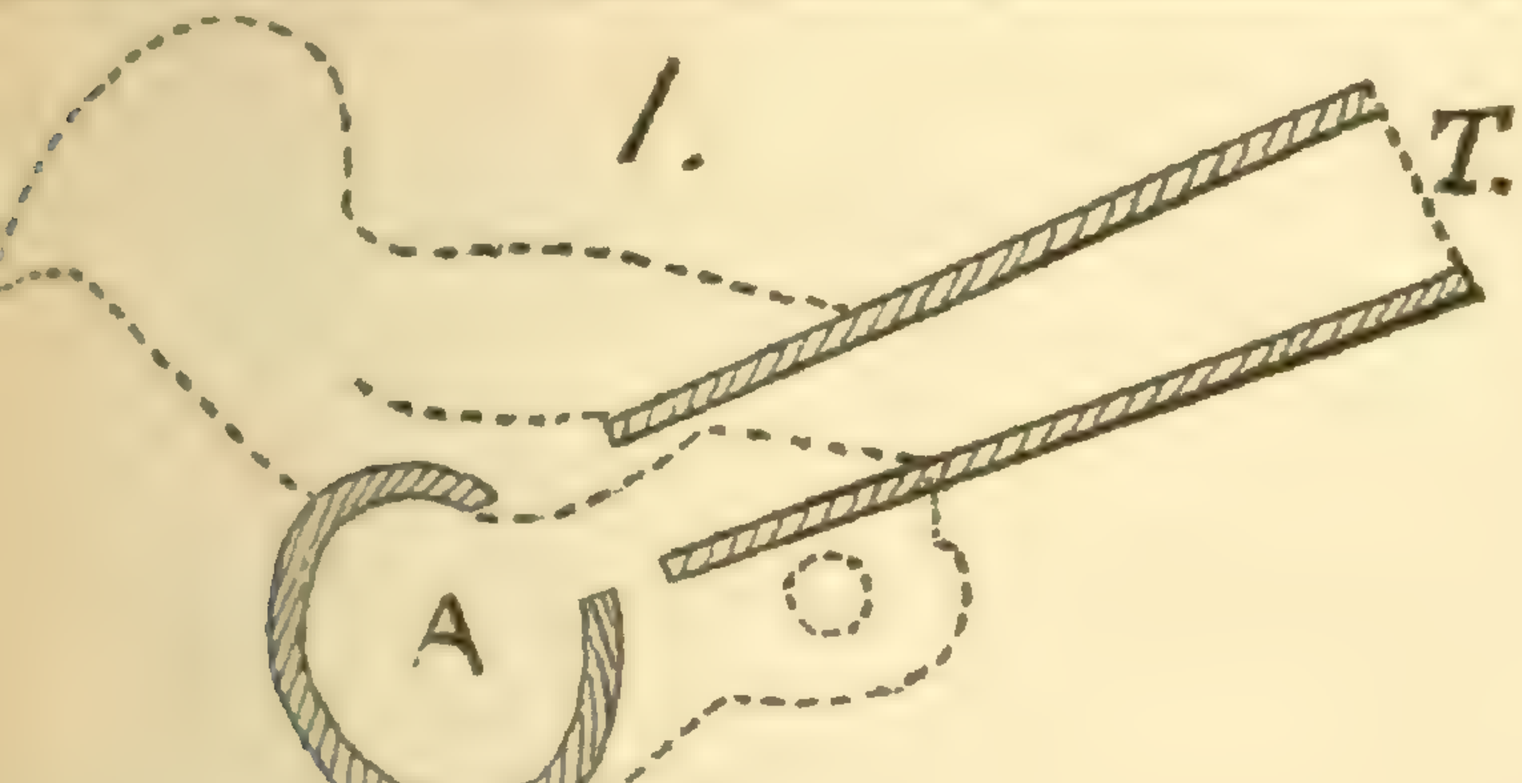
ited the coast of California, may be taken as examples of progression and improvement upon the simple tube and whistle of bone or cane, from the fact that they possess sound-holes, Fig. 6, H, 7, H (Plate XVI) cut for labial manipulation. The clay reed or neck-piece, Figs. 4, R, 11, C (Plate XVI), which resembles the neck-piece of our modern fife, Fig. 9, W (Plate XVI), was probably thus invented, and when attached to the primitive whistles (like those, for instance, found in the graves of the California coast), increased the volume and regularity of sound, forming the simple mouth-piece whistle without a stop-hole. This afterwards became the right-angled Aztec pipe, shown in Fig. 1 (Plate XVI), an end of which was left unclosed (see profile view of pitch-pipe, Fig. 2, J (Plate XVI), a strong proof that its inventor sought diversity of sound. The artisan who designed these ancient Mexican instruments evidently sought to improve their qualities of sound, which at first were shrill and cacophonous. To overcome this defect, the body of the right-angled pipe, Fig. 1 (Plate XVI), was expanded into a globular shape, placed parallel to and in front of the clay reed, and then pierced by a stop-hole, thus producing the pipe, Fig. 3, A (Plate XVII). This stop-hole, which first appears in the right-angled pipe, Fig. 2, J (Plate XVI) as before shown, is a most important step in the development of musical sounds among the Nahuatalacs, as it can be manipulated by closing and opening the same, thus depressing or raising the pitch of the instrument. These stop-holes, doubtless, suggested to the terra cotta instrument-makers of later date their gradual adoption as finger-holes. It is interesting here to remark the increase in volume and sweetness of sound that had been obtained by the ingenious Nahuatalac clay-worker or musical artisan, by elongating the body of the retort-like pipe, shown in Figs. 1 and 3 (Plate XVII), although it produced a somewhat unwieldy, still not ungraceful, instrument, Figs. 5–6 (Plate XVII), which is narrowest at the end of the body nearest the stop-hole, Fig. 5, E (Plate XVII).

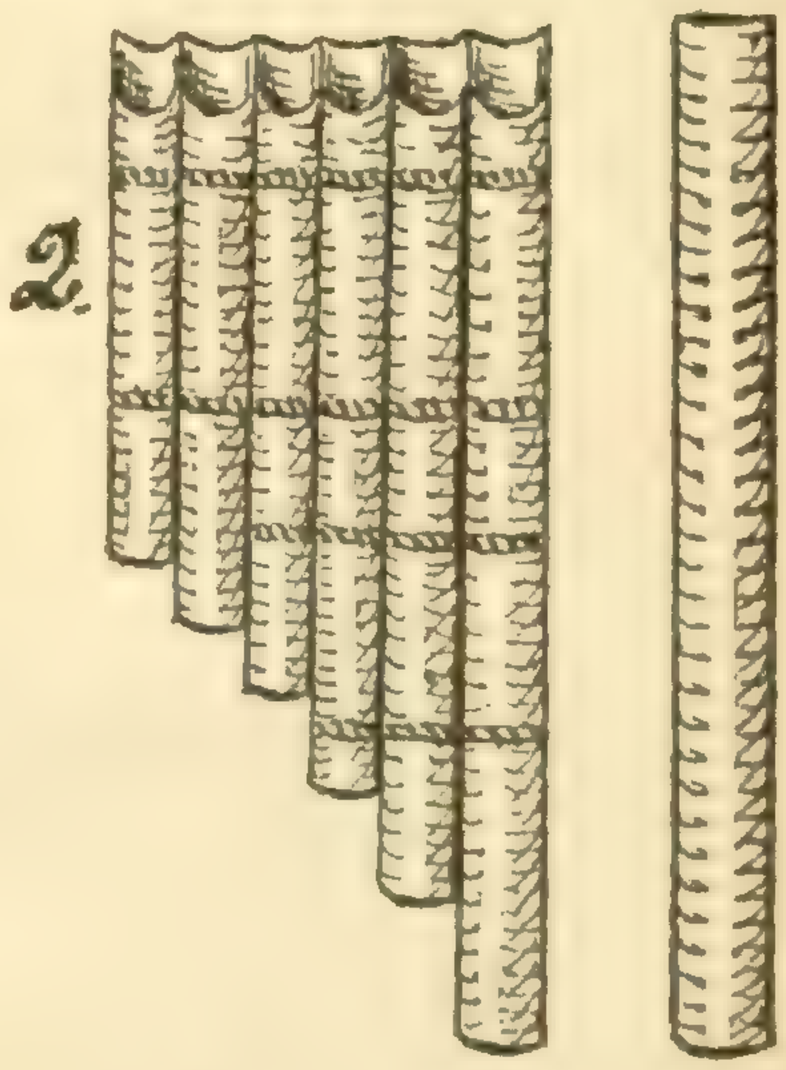
A specimen not unlike this last-named instrument was found upon the Island of Ometepec, in the Great Lake of Nicaragua, by the late Dr. Carl Hermann Berendt; a drawing of it is given by Mr. Barber in his valuable article upon "Indian Music, published in the AMERICAN NATURALIST of March, 1883. The elongated pitch-pipes, Figs. 5–6 (Plate XVII), are perhaps an intermediate form of pipe, between the retort-shaped instruments, Figs.

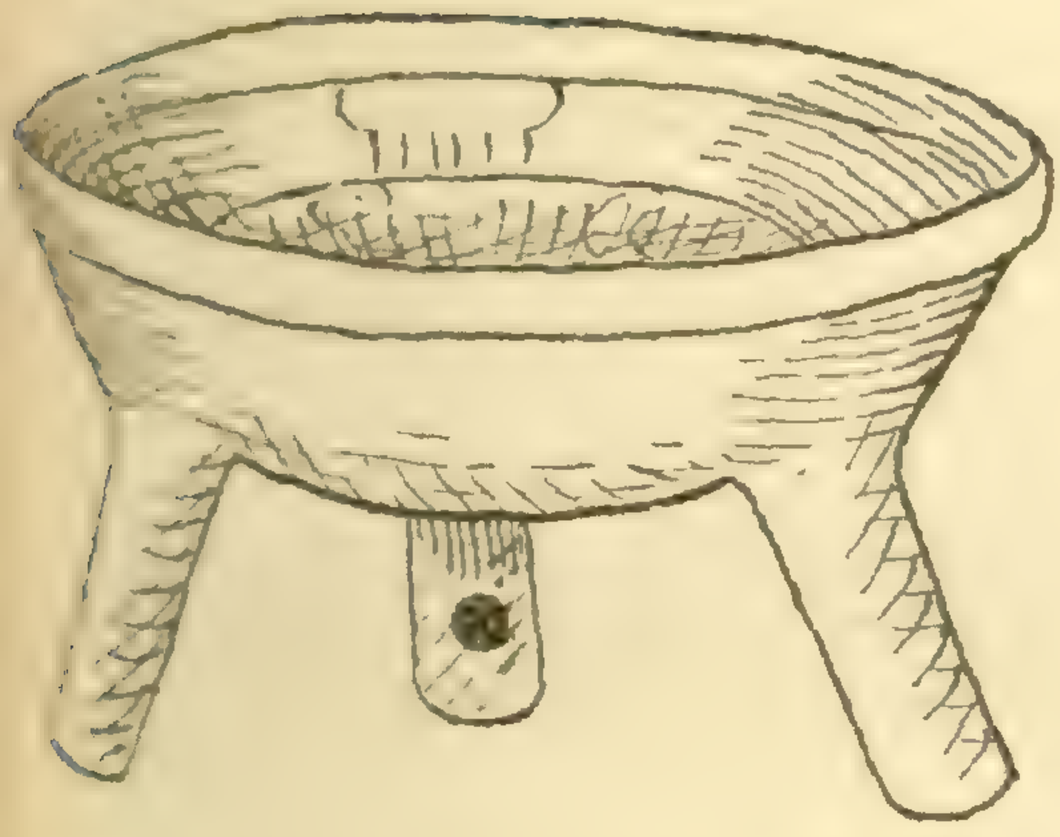
1–3 (Plate XVII), and the four-holed Tezcucan flageolets,[1] whose musical instruments probably attained the highest degree of perfection known to the Nahuatalacs.

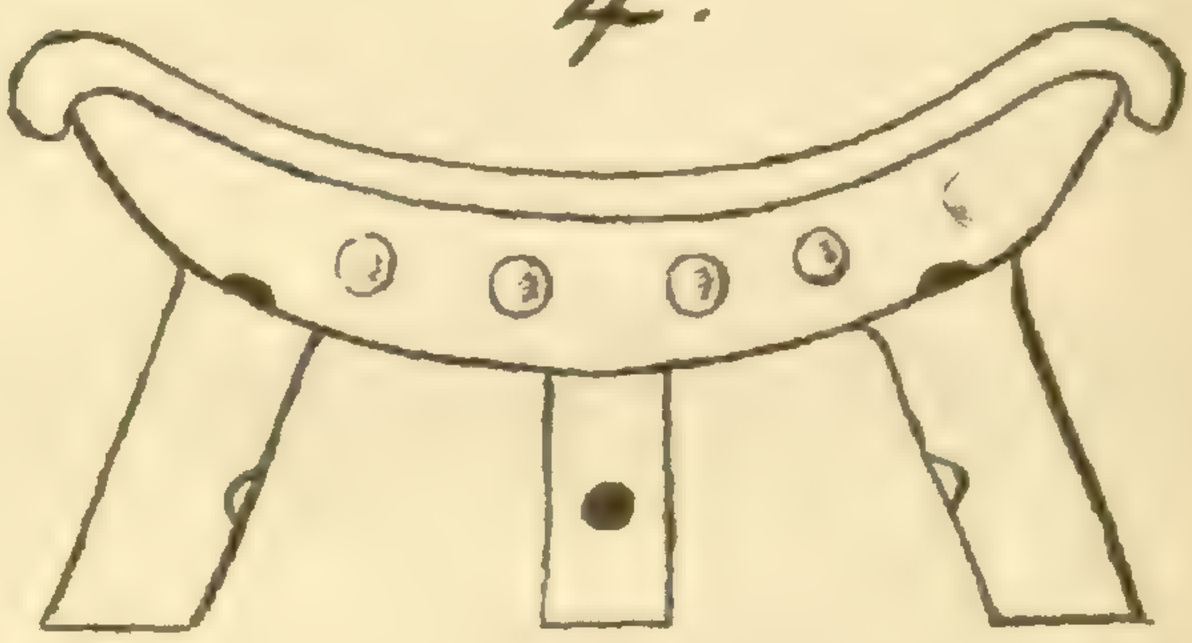
Karl Engel, in his "History of the most ancient Musical Instruments," demonstrates that among ancient nations of the Eastern continent, wind instruments were gradually improved in construction and power of sound. He mentions a pipe found by Captain Willock in the ruins of Babylon (Bis-Nimroud), as follows: "It resembles somewhat the flageolets and whistles of clay found in Mexico and Central America." The pipe in question, Fig. 12 (Plate XVII), copied from Engel's work, "is about three inches in length, and has only two finger-holes, placed side by side, and consequently equidistant from the end at which it is blown. The opposite end has no opening, the instrument, in this respect, resembling a whistle. If both finger-holes are closed it produces the note C; if only one of them is closed it produces E; and if both are open it produces G. Besides these notes one or two others are obtained by some little contrivance; thus by blowing with unusual force the interval of a fifth G may be raised to that of a sixth A, but the fixed and natural notes of the instrument are only the tonic, third and fifth. It is remarkable that the third which is obtained by closing the left finger-hole, is about a quarter tone lower than the third which is obtained by closing the right finger-hole. Perhaps it was intended for the minor third. This is, as far as I am aware, the oldest musical instrument hitherto discovered which has preserved its original condition, yet it is constituted of so fragile a material that were it to fall from the hand to the ground, it would most likely be destroyed forever. But its notes cannot have been clearer two thousand years ago than they are at the present day. The shape of the instrument appears to be intended to represent the head of an animal. This interesting relic, described by Engel, is not unlike the Aztec pitch-pipes, and like the Mexican pipe shows how the simple

[1] The four-holed flageolet of terra-cotta, shown in the plate, was found near the city of Tezcuco, and is probably of Aclolhuan origin, a people whom we are led to suppose were much more advanced in the arts than their blood relations, the Aztecs. An examination of the external contour of this instrument in the plate, Fig. 4 (Plate XIX), will show that the barrel or body of the flageolet is much narrower and more elongated than that of the pitch-pipe, Figs. 5–6, (Plate XVII). The interior construction shows an increased expansion underneath the sound-hole, Fig. 5 K (Plate XIX), and marked contraction at the bell end, Fig. 7 F (Plate XIX).









Ă.B̂. C̆.D̂.

Fig 5. 𝄽 - 3 - 5 - 7 - 7 - 9 - 11 or 𝄽 - 𝄽 - 5 - 5 - 7 - 9 - 11.

Fig 6 - 1 - 3 - 8 - 8 - - - - or 1 - 3 - 8 - 8 - (E. flat)

Fig 7 - 2 - 4 - 6 - 9 - - - or Scale of F (Natural)

Fig 8 - 3 - 5 - 7 - 7 - - - or Scale of D (2 Sharps)

Fig 9 - 4 - 7 - 8 - L. Double whistle*, - Scale of A♭ (4 flats)

Also other interesting Combinations, Viz - - - -

2 - 2 - 6 - 9 - or F (1, flat) - - - - 3 - 2 - 5 - 7. D (5 flats)

6 - 5 - 7. (Octave-missing) G (1, Sharp) or 6 - 6 - 8. L W (G, 1 Sharp)

* L Double Whistle, see fig 4 (Plate 2.)

whistle may be made to produce a variety of sounds by the addition of finger perforations. It also resembles them in its powers of producing different sounds, of a higher pitch, by blowing with unusual force."

As the manipulation of the ancient Mexican pitch-pipes of terra-cotta has never been fully described, some details upon the subject will be necessary. It has been mentioned in a former article that the clay pitch-pipes which stand in the scale of E flat, may be played singly or in quartette. The single manipulation was accomplished by the well-known soloist on the Baehm flute, Professor J. S. Coxe (who having arranged the pitch-pipes in a cardboard frame like a mouth organ), was enabled to play thereon numerous simple melodies. By this means results were obtained (by one performer) like those produced by four persons manipulating them alternately (holding one in each hand). A record has been kept of these manipulations by numbering the whistles from tonic to octave (1–8), and as a ninth, eleventh and twelfth exist (alto a double whistle) the numeration was extended to twelve. As it is necessary, in producing certain intervals and melodies, to close the stop-holes upon some instruments, leaving them open in others, the black dot placed alongside of the numbers or letters indicate closed stop-hole, and the naught open stop-hole. The different signs or modulations for the blowings, shown in Figs. A B C D (Plate XVIII) signify blow evenly (Fig. A sign thus ⌣ turned upward) and blow hard, (Fig. B ⌢ turned downwards).

Where it is necessary to blow very hard, double modulation signs are used (turned upward). In blowing soft, and vice versa, in blowing very hard (turned downward). By this means a method of procedure is obtained by which all confusion can be avoided, and the pipes played with facility. If the note of the large elongated pitch-pipe, Fig. 6 (Plate XVII), standing in A (three sharps), be taken as a tonic note, the intervals of two octaves[1] may be obtained by following the enumerations and stoppings given in Fig. 5 (Plate XVIII). The scale of E flat is given in Fig. 6 (Plate XVIII), also several other combinations of intervals in other scales, such as F

[1] A second method of fingering and stopping is given in Fig. 5 (Plate XVIII), by means of which the intervals of two octaves may be obtained. This fingering, however, owing to some imperfection in one of the pipes, does not produce the intervals clearly. Some of the whistles have been impaired by their long burial.

natural, Fig. 7 (Plate XVIII), D (two sharps), Fig. 8 (Plate XVIII), and finally the intervals of the scale of A (four flats), Fig. 9 (Plate XVIII).

That duplicates of these Aztec pipes of terra-cotta exist (in the Poinsett collection of Mexican antiquities) which are pitched in like keys, has been proven beyond a doubt, viz., three duplicates of the octave or No. 8 pipe (scale of E flat), two of No. 9, two of No. 5 pipes. It is certainly an interesting fact that in a collection of sixteen pitch-pipes, seven out of this number correspond with one another. *This sameness of pitch cannot therefore be attributed to an accidental similarity of musical sounds.*

Terra-cotta pitch-pipes, similar to those shown in Figs. 1 and 5 (Plate XVI), which were excavated in 1852 from an ancient tomb near Vera Cruz, by the late Professor Charles H. Budd, are pitched in like tones to Nos. 8 and 9 in the Poinsett collection.

The Indians of the present day, in various parts of Mexico, manufacture whistles of an inferior kind, which do not, however, in any way approach the ingenious clay-reed pipes of their ancestors, either in construction, tone or decoration, still there is an innate love for music among the descendants of the old Nahuatalac and Maya races, which has frequently been commented upon by travelers. Dr. Habel's learned article entitled "Archæological investigations in Central and South America," published by the Smithsonian Institution in their Contributions to Knowledge, page 45, speaking of the South American Indians, states that he found the pipe the only national instrument. It is of various dimensions, and almost every traveling Indian has one at hand, piping while he walks on the road or in the market.

Whistles fashioned like birds, animals and monsters of grotesque shape are quite numerous in the cemeteries of Mexico and Central America. They generally emit shrill sounds, which Mr. Barber, in his valuable article on "Indian Music," has compared to a peculiar noise like the escape of steam (AMERICAN NATURALIST of March, 1883). Others examined by the writer of this article give harsh sounds when blown into forcibly, not unlike the chatterings of macaws and parrots. They had been modeled in three pieces, viz., the mouth-tube, Fig. 10 T (Plate XVII) and Fig. 1 T (Plate XVIII). The body, which is most ingenious in construction, and bears an important part in the production of the sound emitted, is made in two parts

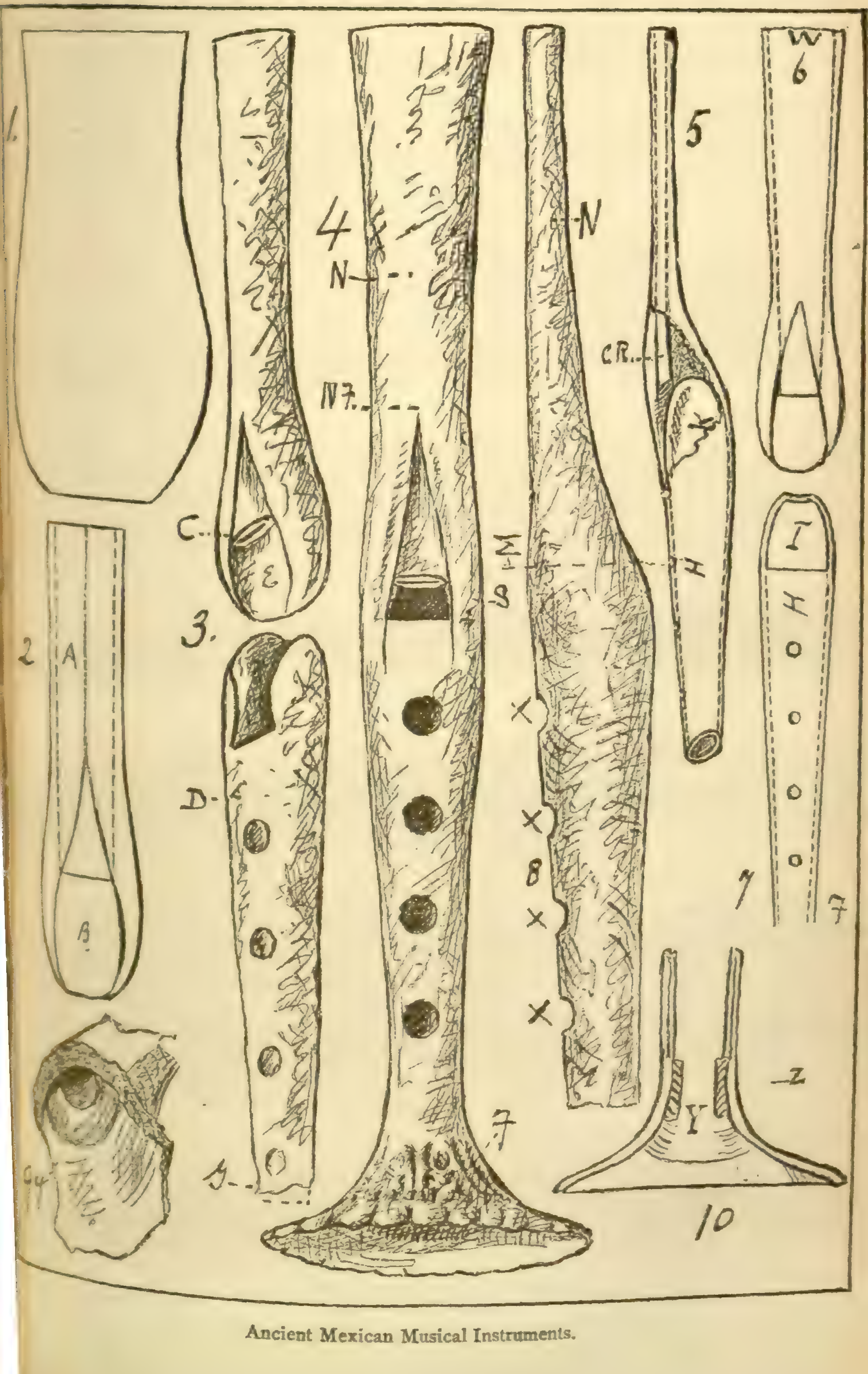
or pieces, viz., the body and cover, Fig. 10 U (Plate XVII) and Fig. 1 A (Plate XVIII). The grotesque whistle, Fig. 8 (Plate XVII), shows the jointure of its several parts, and for this reason it has been chosen for description. The mouth-tube, Figs. 10 T, 9 H (Plate XVII), is of simple construction, having been made upon a round form, narrowest at the end approaching the body portion, see Fig. 10 G (Plate XVII). This illustration has been drawn from an instrument in which the body cover, or top, has been removed. It will be seen that the mouth-tube is held in position by the clay flaps, on either side, opposite a small hole in the body of the whistle, thus directing the current of air into its hollow interior. The body was, without doubt, modeled upon a semi-ovate form, the perforated top being added after it was withdrawn. The position of the body varies in different whistles, but in most cases is tilted, with the flat top-piece (or cover of the semi-ovate body) forward and inward, thus placing the sound-hole exactly in front of the narrow end of the tubular mouth-piece, Fig. 10 G (Plate XVII), conducting the air within, and making the necessary vibration to produce sound. The body cover serves two purposes, that of uniting the body and mouth-tube firmly together, also that of reflecting sound outward, after its production in the semi-ovate cavity.

The four-holed Nahuatalac flageolet of terra-cotta, found near Tezcuco, Fig. 4 (Plate XIX), shows a superior knowledge in its construction, power and variety of sound to any other wind instrument of music manufactured by the North American aborigines excepting, of course, those manufactured by the Inca Peruvians. An examination of the various parts of the four-holed Tezcucan flageolets of terra-cotta will demonstrate that they have been made in four parts. viz., the clay reed, Fig. 2 A (Plate XIX), shown by the dotted lines; neck-covering, or flap, Fig. 1 (Plate XIX); the body, Fig. 3 D, and the bell, or foot, Fig. 4 F (Plate XIX). Sections of these instruments, Figs. 5, 6, 7 (Plate XIX), made in profile, indicate that they were modeled upon round elongated forms. That of the body portion is narrowest at the bell end, Fig. 7 F and 5 K. The shape of the form upon which the neck-piece was modeled, is shown by the dotted lines in Fig. 6, contracting at the sound-hole, and gradually expanding as it approaches the mouth end, Fig. 6 U. The finger-holes (four in number) have been perforated through the body Fig. 8, from the

outside while the clay was in a semi-dry condition. A hollow instrument seems to have been used for this purpose, leaving here and there small ragged edges of clay adhering to the interior of the barrel around the edge of the circular perforations. The bell, Fig. 4 F, is concave exteriorly, of circular form, and decorated with designs of unique patterns which have been stamped thereon by terra-cotta forms or dies. The internal portion of this bell is hollow, becoming convex as it approaches the edges, and contracting at the point of connection with the tube or barrel to a thickness of half an inch. Around this is formed a small cup-like cavity, Figs. 9 y, 10 y, which bears a most important part in manipulating the instrument. It can readily be seen, by an examination of the careful drawings shown in Figs. 9 y, 10 Y (Plate XIX), that these are not accidental formations, as has been suggested, but have been adapted to the form of the finger ends *to serve a particular purpose, viz., that of finger-stopping the bell.* The necks, Figs. 8 N, 4 N (Plate XIX), and clay reeds, Figs. 4 C, 2 A, 5 C R (Plate XIX), of these four-holed flageolets, have been modeled in the same manner as those upon the pitch-pipes, excepting that forms of greater length were required on account of the elongation of the mouth-piece.

The instrument shown in Fig. 4 (Plate XIX), viewed in front, is quite broad at the commencement of the mouth-piece, Fig. 4 (Plate XIX), contracting slightly as it approaches the division of the neck-flap, Fig. 4, N, F, and then expanding to its greatest thickness opposite the sound-hole, Fig. 4, S, where the neck-flap and body portion have been joined together (see section Fig. 5, Plate XIX). From the sound-hole it gradually contracts until the place of junction with the bell is reached, Fig. 3, G, from thence gradually increasing in size until near its lower portion (*i. e.* the bell proper), when the expansion and curvature is quite rapid, forming, at last, a flat plane upon its outer edge. Viewed in profile, Fig. 8, N, the neck is quite delicate, and like the reed in shape, Fig. 5, C, R (Plate XIX), gradually growing larger as the middle of the body, Fig. 8, M (Plate XIX) is reached. A gradual curve from above downwards here unites the mouth-piece with the body, which tapers gradually from this point until its junction with the bell, Fig. 4 F (Plate XIX), thus forming an instrument of graceful contour and artistic construction.

The instruments in the Poinsett collection of antiquities differ



Ancient Mexican Musical Instruments.

somewhat in the color of the glazes by which they are covered. The flageolet shown in the illustration, Fig. 4 (which was found with several others at Tezcuco, in Mexico), is covered with a light-red glaze. In the B flat instrument the glaze is a dark-brown color, and in other fragments of pipes, of like kind and construction, it is a heavy, vitreous glaze of a dark vermilion color, resembling that which covers the tips of the mouth-piece in the pitch-pipes. This glaze, in most cases, when the instrument is of a light color, is covered by one or two bands of a darker hue, generally placed as ornamentations between the first and second finger-holes, thus adding to the variety of the color, which would otherwise be monotonous. It is worthy of remark that ornamental bands of paint *overlie* the original glaze in some cases, and in others, as in the B flat instrument, they *underlie and are covered by it.*

Having considered the construction of the ancient Mexican pitch-pipes and four-holed flageolets of terra-cotta in all their parts, externally and internally, the student of aboriginal American plastic art cannot fail to be impressed with the ingenious construction, artistic feeling and inventive power displayed by the barbarian people who fashioned them. *This, it has been shown, was accomplished by modeling their terra-cottas upon forms* (in pieces), probably made of polished bone or wood. The pieces or sections produced upon the forms in question, were joined together while in a semi-dry or green state, by means of liquid or soft clay (which method is still used by our modern potters), thus enabling the ancient Mexican clay-workers to finish their musical instruments in parts. *The use of piece-forms* seems to have been quite common among the Nahuatalacs and the ancient clay-workers of Nicaragua,[1] Costa Rica and Peru in manufacturing

[1] The ancient pottery manufactured by those people who once occupied that portion of Central America now called Nicaragua, suggests, by its superiority of execution and glaze, that the potter's art here attained a higher degree of excellence than among the Aztecs, and in many respects, such as delicacy of form and finish, is equal to that of the Inca Peruvians. A good example of this is shown by a tripod vase, Figs. 3 and 4 (Plate XVIII), brought from Nicaragua by the late F. G. Smith, Esq., in 1859. It was found on the Island of Ometepec, in the Lake of Nicaragua, in a perfect condition, and during its transportation to the United States it was broken through the middle, thus revealing its interior construction. It will be seen by an examination of the careful drawing (showing a section thereof) that the body portion and legs were hollow and filled by small clay balls. It is the opinion of those skilled in the potter's art that this unique tripod vase could not have been made ex-

certain kinds and portions of their intricate terra-cotta fictile wares.

In conclusion, it is also worthy of remark that a knowledge of the process of modeling in clay upon forms seems to have been known to most all of the savage and barbarian nations of America who were acquainted with the art of pottery, and more especially to those of our American aborigines, who occupied the middle status of barbarism. Many of the beautiful earthenwares from the mounds of Louisiana, Missouri and those parts of our Western States at one time occupied by the mound-builders suggest the use of forms or shapes. Specimens of ancient water bottles from British Guiana and the (long-necked) bottle-shape jars and vases from the mounds of Indiana, Tennessee and Missouri in the William S. Vaux and Haldemann collections, prove the truth of these assertions.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— *E pur se muove.* The Philadelphia Academy has added two professors to its corps, and, it is said, will soon add a third. As the gentlemen selected are all capable, original investigators, important progress has thus been made. In fact, the organization adopted eight years ago may now be said to have the active support of the members of the academy.

The institution having at length acquired a center of vitality, new questions arise. Having escaped the Scylla of paralysis, it must avoid the Charybdis of being pressed into service which does

cept upon piece forms, and that the pieces modeled thereon were united during the semi-dry or green state. The clay balls in the interior of the legs and body portion are the best proof of this assertion, as they must have been placed therein during the jointure of the vase, before the firing process (see Fig. 4, Plate XVIII, where a section of this vase is given, showing the position of the clay balls between the plates of earthenware that form the body). It will be seen that these two concave disks are united together and so fashioned as to leave a space within, into which the pellets of clay were placed. There is no connection between the body part and legs except by delicate perforations about the size of a pin's head, leading from the body into the legs. The legs, in their turn, are perforated by small holes of a like kind, thus allowing the heated vapors to escape during the firing. The theory advanced by certain writers that the clay balls in the interiors of the Mexican Jacaxtli (and other hollow terra-cottas) were detached by a sharp cutting tool, after the firing, is an absurdity which no careful student of aboriginal American plastic art will credit.

not belong to it. Some of its members desire to make it a school for teaching science to the young, a function which does not belong to an academy of sciences, but to a university or other school. That the primary object of the academy has always been original research, is well known; and that it is the desire of most of the scientific specialists connected with it that it should be devoted to that purpose, is undoubted. Instruction to post-graduates might be given in connection with its laboratories of research, but not to such an extent as to interfere with the main object.

The inaugural address of Professor Sharp was a clear exposition of the methods employed in some of the continental laboratories, and furnished an outline for work to be done in his own department, invertebrate zoölogy, in the academy.

One reason for introducing this institution so frequently to the notice of our readers is, that it is representative of the average local American "Academy of Sciences." If these institutions are ever to resemble their prototypes of the old world, it will have to be by a process of growth something like that which the oldest academy in the country is undergoing. They will have to pass from the club stage to the working stage, and self-preservation will require a third more or less exclusive stage. The obstacles to be overcome will be very similar everywhere.

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RECENT LITERATURE.

DUTTON'S TERTIARY HISTORY OF THE GRAND CANON DISTRICT.[1] —This elaborate monograph on perhaps the most imposing gorge in the world, has been thoroughly well done and superbly illustrated. The author gives a rapid summary in the twelfth chapter of the changes which have taken place and have produced the present wonderful scenic features of this region. Before the Carboniferous period thick beds of Silurian and thinner deposits of Devonian sediments were laid down, though a guess whence they were derived is not hazarded. The region was then upheaved, enormously eroded and again submerged. Upon the eroded surface the Carboniferous rocks were unconformably deposited, and the deposition of sediment was continued until the end of the Mesozoic, resulting in the accumulation of from 12,000 to 16,000 feet of strata over the entire Plateau province. The Carboniferous deposits may have accumulated in an ocean of

[1] *United States Geological Survey.* J. W. POWELL, director. Tertiary History of the Grand Cañon district, with atlas. By Captain CLARENCE E. DUTTON, U. S. A. Washington, Government Printing Office, 1882. 4to, pp. 264.

moderate depth, but the Mesozoic beds were all shallow-water deposits, and they sank as rapidly as they accumulated.

"Near the close of the Cretaceous, signs of the coming revolution make their appearance. The waters became brackish, indicating a restricted access of the ocean. At the close of the Cretaceous important disturbances took place, and portions of the province were uplifted and denuded. These were again submerged, but the new conditions differed from the old, for the new deposits (Eocene) laid down unconformably upon the Cretaceous and Jurassic are of fresh-water origin, indicating that a great lake was formed. The extent of this lake corresponds very nearly with that of the Southern Plateau province itself, but not exactly. Near the Middle Eocene began that slow action which has gradually elevated the western portion of the continent, and which has prevailed until a recent epoch."

During the Tertiary, erosion went on continuously, the thickness removed from some large areas amounting to about 10,000 feet, and much the greater part of this denudation was probably accomplished by the close of the Miocene.

"The Colorado river appears to have originated in very early Tertiary time as the outlet of the great Eocene lake, and has persisted in its course ever since. It has been the main track along which the waste of the province has been carried to the Pacific. At its beginning its bed lay in Eocene strata, and as the land rose it cut down its channel by corrasion, severing in succession all the beds of the Mesozoic and Carboniferous systems. That portion of it which constitutes the Grand and Marble cañons has cut through 10,000 to 16,000 feet of beds, reaching a maximum amount in Kaibab. The present Grand cañon represents only the corrasion through the Carboniferous and into the Archæan. The older corrasion of superior beds becomes manifest only when we restore, in imagination, the Mesozoic strata which have been denuded from the vicinity of the chasm. The present Grand cañon, therefore, is the work of late Tertiary and Quaternary time. Although we cannot fix with precision the exact epoch at which the river first penetrated the Carboniferous beds, we may, in roughly approximate language, place that epoch near the beginning of the Pliocene or close of the Miocene."

Among the more interesting points elucidated besides the gorges of the Colorado, are the basaltic eruptions of older and some of very recent date. After describing the ancient basalts of Mt. Trumbull and other masses, which are much eroded, attention is then drawn to the fields of recent basalt, which look "as fresh as any *coulée* of Vesuvius ejected twenty or thirty years ago." Plate XX represents one of these fields. Compared with the other later eruptions of the Uinkaret, its dimensions are larger than the average. It entire surface is covered with blocks of pumice of the most delicate kind. It has a texture very much

like the lightest coke, the vesicles, however, being considerably larger than those of the ordinary coke, and very uniform throughout. The septa between the vesicles are very thin, and the whole mass is so light that wh[illegible]pecimen is varnished over to prevent access of water to [illegible]vities, it floats upon water like a cork. * * * Any at[illegible]pt, however, to fix the age of these lavas must prove quite fruitless. All that we can say is, that it is very recent, even when time is judged by the historic or human standard. It cannot be many centuries old, and it may be more recent than the Spanish conquest. But there are reasons why lavas should here preserve for centuries the freshness which is lost in other countries in as many decades. The climate is arid, and there can be no question that the chemical action of the meteoric agents upon the lavas proceeds here with extreme slowness.

The volume ends with a discussion of the mode of excavation of the Grand cañon, of corrasion and weathering, and finally with a treatment of the details of its erosion.

Not only for its full and well written account of the geology of an extensive as well as not very accessible region, will the volume have its use, but especially as a contribution to dynamical geology, with regard chiefly to the action of running water and weathering, will this volume possess permanent value.

It is hardly necessary to add that the pencil of Mr. Holmes, whose genus for sketching geological panoramas is almost unique, has added materially to the value of the work. The wood-cuts and photo-engravings are drawn in his superior manner, while the chromo plates evince his facility in the use of water-colors.

Capt. Dutton's style and mode of handling his subject is clear and elaborate, and worthy of the subject. The atlas is in Bien's best manner.

Garman's North American Reptiles and Batrachians.[1] —The first-named of these brochures, as a simple catalogue is by itself of little weight as a contribution to science, but as connected with the illustrated paper which bears the second of the titles given below, and as a possible prodromus of others, it deserves attention. The system of the Bulletin No. 1 of the National Museum (which is devoted to this subject) has been so generally adopted by American herpetologists that it becomes necessary that some good reasons should be adduced for the many differences from it which the present system and list present. These reasons have not been given, so far as we are aware, and we think it can be shown that none can be found.

The author of these papers has clearly not been equipped for the task he has undertaken. In the systematic department he

[1] *A list of the species occurring north of the Isthmus of Tehuantepec, with references.* From the Bulletin of the Essex Institute, Salem, Jan., 1884. On the Reptiles and Batrachians [of the Kentucky Geological Survey]. From the memoirs of the Museum of Comparative Zoölogy, Cambridge, Mass. 4to (no date).

creates a number of new names, including two new generic names, which is an inexcusable proceeding, because the names are unnecessary. His selection of genera for adoption is purely arbitrary. Most of the rejected stand on as valid basis as those adopted, some of them on identical characters, as, for instance, Eutaenia rejected and Ophibolus adopted, both resting on the entire anal scutum. The adoption of specific names is equally arbitrary. Of both kinds of types the author not infrequently displays remarkable ignorance. Thus the genus Hypsiglena Cope, is adopted, but a species of that genus, *H. torquatus*, is placed in Sibon, and two distinct species of the latter genus are placed under the "*S. torquatum*" as varieties or sub-species. So with *Sympholis lippiens* Cope, which appears in one place as a species of "Gophis," and in another under the synonym *Chilorhina villarsi* Jan., as a distinct generic form. *Contia episcopa* appears under the sub-generic head Contia, while its variety, *C. isosona*, is placed under the sub-generic head of Sonora. The *C. pygæa* is not in the list at all. There are, in fact, several omissions of North American species, and so many Mexican species are omitted that the title of the paper is misleading. The arrangement of the species within the genera is confused, and does not in any way express their mutual relations. As an instance we refer to the collection of species he calls Geotriton. Four species of Spelerpes head the list, then an Œdipus (*O. variegatus*), then a Spelerpes, then an Œdipina, then four Spelerpes, then two Œdipus; then follows a Stereochilus, then a Eryinophilus, then a Spelerpes, and finally an Œdipus identical with the fifth on the list above named. No species of Geotriton appears. When we compare this suppression of genera with those adopted among the tortoises, at least nine of which are worthless, the inconsistency is striking.

The author of the catalogue has a singular plan of applying to a species the name of the author of the paper or work in which the description first appeared, although it may have been composed and written by another person whose name has been given as that of the true author. Thus Dr. Deyis has the pleasure of learning that the *Adelophis copei* was described by Cope and not by himself. All the species described by Cope in the Zoölogy of the Wheeler Survey are attributed to Yarrow, the zoölogist of the expedition; those published by Cope from Baird's manuscript are attributed to Cope, but with the complimentary insertion of a "Bd." in parentheses.

To correct this list would be to rewrite much of it. We only add that the *Diploglossus millepunctatus* O'Sh., is what Mr. O'Shaughnessy took it to be, and is not a Eumeces, as supposed by Mr. Garman; and that the list of species of Ophibolus is a miracle of confusion.

As with the genera, the adoption of species and subspecies is entirely arbitrary, and appears to depend on nothing but the fancy

A lateral Amphitheater of the second order in the Grand Cañon.

of the author. An example of this may be seen in his species of Crotalus. Besides ignoring some good species, he adopts the *C. polystictus* under the later name, *C. ximmesii*, while he places the name *C. polystictus* as a synonym of the different *C. triseriatus* of Wagler. The quarto volume referred to contains a number of good plates, which gives some value to the work. On the whole, however, we think the author should have waited until his knowledge of the subject was more complete before attempting to publish.

GALTON'S RECORD OF FAMILY FACULTIES.[1]—This book is a series of blanks designed for those who may desire to forecast the mental and bodily faculties of their children, and to further the science of heredity. As stated in the preface, the natural gifts of each individual being inherited from the ancestry, it is possible to foresee much of the latent capacities of a child in mind and body, of the probabilities of his future health and longevity, and of his tendencies to special forms of disease, by a knowledge of the traits of his ancestors. When the science of heredity shall have become more advanced, the accuracy of such predictions will improve, and meanwhile we may feel assured that fewer blunders will be made in rearing and educating children, under the guidance of a knowledge of their family antecedents, than without it.

It is to be hoped that those at all interested in the improvement of the race in general, as well as their own descendants, will make a fair trial by keeping such a record as this, and we hope that similar blanks may be issued in this country by our boards of health, a work which has already, we believe, been done in Massachusetts.

In reading the introduction, and looking over the blanks, we may obtain some idea of what of a practical nature is involved in the idea of heredity. It is the custom with many to make light of heredity, as if there were little in the matter; whereas, the intelligent observer is well aware that, together with variation, heredity is one of the twin forces in the world of life.

One is proud of his distinguished ancestors, but in such a record as this, equal attention is paid to the claims of eve y ancestor in the same degree of kinship. "No countenance is given to the vanity that prompts most family historians to trace their pedigree to some notable ancestor, and to pass the rest over in silence. It demands an equal recognition of all the lines. We should remember the insignificance of any single ancestor in a remote degree. In the fourth generation backwards there are sixteen ancestors, from whom the child receives on the average an equal inheritance. In the fifth there are thirty-two. One ancestor who lived at the time of the Norman conquest, twenty-four

[1] *Record of Family Faculties*, consisting of tabular forms and directions for entering data, with an explanatory preface. By FRANCIS GALTON, F.R.S. London, Macmillan & Co., 1884, 4to.

generations back, contributes (on the supposition of no intermarriage of kinsfolk) less than one part in 16,000,000 to the constitution of a man of the present day."

Mr. Galton thinks that if the father of a family of children collects all the required data concerning his own parents and grandparents, and similarly those concerning the parents and grandparents of his wife, then it is probable in most cases that their children, being informed about all their ancestry up to their eight great-grandparents inclusive, will be equipped with almost as much hereditary information as they can need.

Thus far our ignorance, the author claims, of the conditions by which the level of humanity may be raised, is so great that he believes "if one had some dictator of the Spartan type, who exercised absolute power over marriages, assigning A to be the wife of B, and C to be the wife of D, and who acted with the best intentions, he might possibly do even more harm than good to the race." No man is isolated from his fellows, but is "a prolongation of his ancestry in no metaphorical sense," and the author claims that the compilation of these registers will extend this conviction very widely. In order to obtain statistics bearing on heredity, Mr. Galton offers £500 in prizes to those British subjects resident in Great Britain who shall furnish him with the best extracts from their own family records.

Balbiani's Lectures on the Sporozoa.[1]—The class of Sporozoa was founded by Leuckart in 1879, by whom it was regarded as a new group of Protozoa. Besides the Gregarines it embraced all those parasitic unicellular organisms called Psorosperms. Besides the oviform Psorosperms or Coccidia of Leuckart, in 1881 Bütschli proposed the name of Myxosporidia for the Psorosperms of fishes. In 1882, in his lectures, Professor Balbiani suggested the term Sarcosporidia for the utriculiform Psorosperms, while he places among the Sporozoa a fifth group, which he designates as Microsporidia, comprising the vibrating corpuscles of the silk-worm and allied organisms, regarded for a long time as Psorosperms by Leydig and himself.

As thus constituted we have, for the first time, in this useful work a succinct and interesting account of these strange parasites, which are so widespread throughout the tissues of all animals, from the Infusoria to man, and which correspond to the Bacteria among the Protophytes. One of them causes fatal sickness by its rapid and extreme multiplication in the liver of the hare, and has also once occurred in man, producing death. Several of them propagate epidemically, and give rise to more or less fatal epizootics; such are the Sarcosporidia of the sheep and poultry, which

[1] *Cours d'Embryogenie comparée du College de France. Leçons sur les Sporozoaires.* Par G. Balbiani. Recueilles par le Dr. Pelletan. Revues par le Professeur. Avec 52 figures intercalées dans le Texte et 5 Planches lithographiées hors texte. Paris, 1884. 8vo, pp. 184.

sometimes decimate the sheep-folds and poultry yards. A great number of fresh-water fishes die owing to the development of Myxosporidia in their tissues, a cause of destruction of these animals in our fish ponds which is still generally ignored. Finally, says the author in the preface, the epidemic invasion of the Microsporidia in silk-raising establishments gave rise to the disease called *pebrine*, which for twenty years has nearly ruined the silk industry throughout the world, and cost France alone more than a millard francs.

Professor Balbiani adds that while MM. Aimé, Schneider and Bütschli have recently enriched the history of the Gregarines and Coccidia, his own contributions relate chiefly to the Myxosporidia and Microsporidia.

After describing the Sarcosporidia, or tubular Sporozoa, he discusses their systematic position, acknowledging the difficulty of correctly classifying them, but following Leuckart in regarding them as animal rather than vegetable. These organisms live as tubular masses of ovoid organisms buried in the muscle of the pig, Otaria, etc., and Balbiani believes that they begin by living on the surface of their host.

The Myxosporidia, or Sporozoa of fish, are treated in an interesting way, with a number of original sketches.

In the chapters on the Psorosperms of articulates (Microsporidia) we have an interesting historical sketch of the discovery of these parasites, which were first detected in 1853, by Leydig in *Coccus hesperidum*, and afterwards in spiders, a bee, a crane-fly and in Daphnia. These he regarded as vegetables, but as belonging with the Psorosperms. Here belongs the organism which causes pebrine, and which Pasteur regards as *organites*, but neither animal or vegetable. This view Balbiani combats with considerable feeling and at considerable length, fortifying his position with sketches, maintaining that they are animal and belong with the Sporozoa.

Report of the Geological and Natural History Survey of Canada for 1880–'81–'82.—We have but just received this report, which bears date of 1883. With it comes a catalogue of Canadian plants, Part I, Polypetalæ, by John Macoun, forming a volume of 192 pages, and containing interesting notes on the occurrence and distribution of the species. We should have expected to find more detailed notes on the Labrador species than we do.

The geological report itself being for a period extending through three years, cannot here well be analyzed. Dr. G. M. Dawson makes a preliminary report on the geology of the Bow and Belly River region, Northwest Terr., with special reference to the coal deposits; Dr. R. Bell reports on the geology of the basin of Moose river and adjacent country, and on the geology of the Lake of the Woods and region adjoining. The most elaborate

reports are those of Mr. R. W. Ells on Northern and Eastern New Brunswick and the north side of the Bay of Chaleurs, as well as the Gaspé peninsula, illustrated by several folding maps. Artotypes and lithographic plates illustrate the scenery.

Besides his introductory reports the director of the survey, Dr. A. R. C. Selwyn, furnishes a chapter entitled: "Geological nomenclature and the coloring and notation of geological maps," which will attract attention.

Recent Books and Pamphlets.

Ashburner, C. A.—First report of progress in the Anthracite coal region. The geology of the Panther Creek basin. Second Geol. Surv. Pa. Harrisburg, 1883. From the author.

Riley, C. V., Packard, A. S., Thomas, C.—Third report of the United States Entomological Commission. Washington, 1883. From the commission.

Chapman, H. C.—History of the discovery of the circulation of the blood. Phila., Blakiston & Co., 1884. From the author.

Gill, Th.—The principles of zoögeography. A presidential address delivered at the Biological Soc. of Washington, Jan. 19, 1883. From the author.

Dollo, M. L.—Premiére note sur les Crocodiliens de Bernissart. Ext. du Bull. du Mus. Roy. d'Hist. Nat. de Belg., 1883. From the author.

——Note sur la presénce du *Gastornis edwardsii* Lemoine, dans l'assise inférieure de l'étage Landenien a Mesvin, près Mons. Ext. idem. From the author.

Curtis, J. S.—Abstract of report on the silver-lead deposits of Eureka, Nevada. Ext. Ann. Rep. Director U. S. Geol. Surv. From the author.

Hyatt, A.—Genera of fossil Cephalopods. Ext. Proc. Bost. Soc. Nat. Hist., 1883. From the author.

Whitehouse, Cope.—The myth of Fingal's cave. From the author.

Clevenger, S. V.—Clinical and pathological reports of cases of insanity. Rep. from the Chicago Med. Jour. and Exam., 1884.

——Paretic dementia in females, with report of a case. Rep. from the Alienist and Neurologist, 1884. Both from the author.

Campbell, J. L., and Ruffner, W. H.—A physical survey in Georgia, Alabama and Mississippi, along the line of the Georgia Pacific Railway. New York, E. F. Weeks, 1883. From W. H. Ruffner.

Christy, R. M.—On the methodic habits of insects visiting flowers. Ext. Linn. Soc. Jour., 1883. From the author.

Randolph, N. A.—A study of the distribution of gluten within the wheat grain. Ext. Proc. Nat. Sci. Phil., 1883.

——A note on the fæces of starch-fed insects. Ext. Trans. College Physicians of Phila., 1883. Both from the author.

Roussel, A. E., and Randolph, N. A.—An examination of the fæces of twenty persons receiving inunctions of cod-liver oil. From the authors.

Williston, S. W.—On the North American Asilidæ, with a new genus of Syrphidæ Ext. Trans. Amer. Ent. Soc., 1883. From the author.

Wilder, B. G.—Cartwright lectures on methods of studying the brain. Lecture No. 1. Ext. N. Y. Med. Jour., Feb. 9, 1884. From the author.

Sewall, H.—Experiments upon the ears of fishes with reference to the function of equilibrium. Ext. Jour. of Physiology, 1883. From the author.

Ryder, J. A.—Rearing oysters from artificially-fertilized eggs, together with notes on pond culture, etc. Ext. Bull. Fish Commission, Vol. III, 1883. From the author.

Worthen, W. A., St. John, O., Miller, S. A.—Geological survey of Illinois. Vol. VII. Geology and palæontology. Boston, 1883. From the authors.

Dobson, G. E.—A monograph of the Insectivora, systematic and anatomical. Parts I and II. London, J. Van Voorst, 1883. From the author.

GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Perak and its Tin.*—The little state of Perak, upon the western shore of the peninsula of Malacca, is in a fair way to become the world's principal center of tin production. Perak occupies a district about ninety miles long by fifty wide, and is traversed by three chains of mountains parallel to the sea. These mountains are separated by plains, the chief of which is traversed by the Soungi Perak, or river of silver, a fine stream some 150 miles long, and navigable for Malay barks throughout most of its length. European ships of more than 500 or 600 tons cannot ascend beyond Dourian Sebatang, at which point the river turns westward toward the sea.

The temperature is equable, rarely exceeding 95°, or sinking below 76°; the alternation from the wet season (September to February) to the dry producing no change upon the temperature.

The mountain masses of Perak are granitoid. Sedimentary rocks occur only in patches, but almost the entire surface of the plains is covered with drift. The tin occurs in quartz veins in the granitoid rocks, and is in the form of the oxide known to mineralogists as cassiterite. The encasing rock of these veins, as is the case in Cornwall, is a porphyroid granite, with large crystals of feldspar.

The Island of Hainan.—This large island is not salubrious. Much of the soil on the coast is marshy, and fever rages both in the marshes and in the woods. The water contains much vegetable and mineral impurity; typhoons destroy the harvest before it is ripe, and Cantonese pirates make frequent descents upon the coast, and seize the trading-junks of the merchants. The natives are to all appearance like other Chinese, but are held in contempt and abhorrence by even the poorest boatmen of Canton.

The port of Hoi-how, with about 12,000 inhabitants, has really no harbor, but is exposed to typhoons and to the north wind. It is upon a river, and ships cannot approach within two miles of it. Some three miles distant is Kiungchow, the capital of the island.

On the main land opposite is the flourishing port of Pakhôi, the center of a large legitimate and larger contraband trade. Its harbor is an excellent one, extensive, deep, and well protected from storms.—(*Ch. Labarthe, Rev. de Geog., Janv., 1884.*)

The Savages of Indo-China.—Dr. Neis (Bull. de la Soc. de la Geog., 1883) recounts his adventures among the various tribes of Mois, who inhabit the country to the north and east of French Cochin China and west of Anam. The Traos, Stieng, Shop, Late, and Thioma are tribes of Mois, among which the Late seem to be the most defenceless. They have no fire-arms, and

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

when the Stiengs pursue them to procure slaves for the Laotians their only defence, except flight, is to plant sharpened bamboos in the paths. Our traveler also visited the remains of the Tsiampa, whose language resembles that of the Malays.

The New Hebrides.—M. Roberjot (Bull. de la Soc. de Geog., Paris, 1883), describes these islands, commencing with Annatom, the most southern. In the islands generally the males greatly exceed the females in number. In Annatom the latter are but six per cent of the population of 1215. Tanna has 4000 natives; the women wear a skirt of bark and cocoa-palm leaves, the men less still. The island is an active volcano. Erromango is entirely madreporic, and is the greatest source of sandal-wood. Sandwich island is also of coral. Near the village are seventeen hollow trunks of trees pierced with holes and a long slot on one side. By striking these a rude music is produced. In Mallicolo two upper incisors are struck violently out from all females of the age of puberty. Wooden tom-toms exist, with carved faces. The inhabitants are about 6000. Ambrym is a volcano, 1067 meters in height.

Spiritu Santo is the largest island, and is bordered to the south by a chain of coral islands. Two rivers flow into the canal between these islets and the main island. In this island the men assist in carrying burdens, which is not the case in the other islands.

AFRICA.—*South Central Africa.*—Mr. Anderson has recently transmitted to the Royal Geographical Society extensive notes and a map of the region between the Orange and Vaal rivers and the Zambesi, from ocean to ocean. The chief sources of the Vaal are in a district called New Scotland, where there are numerous small lakes, among them Lake Cressie, at an elevation of 5813 feet. The central part of the Káláhárá desert is traversed by the Omaramba, Black and White Nosop, Oup, and Elephant's river, all flowing southward into the Molapo, which runs westward at a little north of 26° S. lat., finally turning southward and entering Orange river under the name of Hygap. The Káláhárá desert extends northward to the Chobe as far as its junction with the Zambesi, from which point its eastern boundary runs nearly south to the Molapo, which it crosses further to the west, and extends to Orange river near Kheis. The Chobe rises much farther north than was supposed, as does also the Cubango, which, with the Okayanka Laagte, form the Tonka, flowing into Lake Ngami. Most of these rivers consist, during most of the year, of stretches of water alternating with dry beds. The Zouga flows between Lake Ngami and the great Makarakara Salt Vlei, and it is so level that in April and May it flows eastward; in June and July, westward. From the Zouga, near its exit from Lake Ngami, the Matabe runs to the Zambesi. This Matabe is the only outlet for

the waters of the Zouga and of the lakes; but occasionally, when there is no overflow, it runs southward.

Between the Hygap and Great Fish rivers, at about 27° S. lat., flows the Back river, with two outlets. The Great Fish river rises in S. lat. 22° 40′, flows south, and enters Orange river about ninety miles from its mouth. West of this river is a mountain country of granite, gneiss and trap, drained by numerous tributaries of the Great Fish river. The coast west of these mountains is a sandy desert, extending seventy miles inland. The upper courses of the Swakop, Kuisip and Omaruru are in a fertile country, among granite mountains, some of which attain an attitude of about 9000 feet, but the lower courses of these rivers pass through desert. Most of Ovampo-land, between the Cunene and the Káláhárá desert, is a high table-land, and is very healthy. The Káláhárá desert scarcely seems to be a desert in the usual sense of the word, but to be almost wholly a level, swampy region, with much jungle and many salt-pans. The rivers and salt-pans are, to a great extent, dry during much of the year, and the region is very unhealthy. Bushmen are the principal inhabitants. The eastern part of the belt surveyed, north of the Orange river, is drained by the Limpopo or Crocodile river, the sources of which are on the northern slope of the great water-shed that runs across the Transvaal south of Pretoria. The small lake from which flows the Marico affluent of the Limpopo is only ten miles distant from the eye or lake-source of the Molapo. The region around the Marico and the Notuane, an affluent of the Limpopo from the west, is described as healthy and well-wooded, with lovely mountains and park-like valleys. Other important tributaries entering the Limpopo from the Matabele country to the north of it, are the Makalapsie, Maclutsie, Shasha and Nuanettie, all flowing through a mountainous land, and having many branches. The water-shed of the Molopo mountains, averaging about 4300 feet in height, divides the affluents of the Limpopo from the Gwaii, with its tributaries the Kagane, Amatza, etc., and from the Umnyaki, all of which flow into the Zambesi. The country east of the Sabia, which, rising in the Molopo mountains, flows eastward to the Indian ocean, is ruled by the Zulu chief Umzila, and has not been thoroughly explored.

AMERICA. — According to Mr. Im Thurn, whose travels in British Guiana have recently been published, there is in the far west of that country, or over the Brazilian boundary, where the savannah itself rises 5000 feet above the sea, a flat table-land, the edges of which are more or less perpendicular cliffs 2000 feet high. No traveler has ever been round it, so that it may be accessible from the other side, and there is a way, as yet untried, which Mr. Im Thurn believes may prove practicable. The summit of this plateau of Roraima seems to be forest-covered, and enough is known of the fauna and flora of the district to make it

certain that a naturalist would find himself well rewarded for the ascent. There are traditions of strange isolated tribes that live in this inaccessible region.

Professor Geo. Davidson has communicated to *Science* the following particulars of recent volcanic action in Alaska:

The explosion of October 6, 1883, split perpendicularly in twain the mountain of St. Augustin, situated on the island of the same name, forty-nine miles west of the settlement on Port Graham or English harbor, in Cook's inlet, Alaska. Vast columns of smoke were seen to rise from the summit of the mountain, a column of white vapor rose from the sea near the island, and a great earthquake wave, twenty-five to thirty feet high, came upon Port Graham, followed by two other waves, estimated at eighteen and fifteen feet. Had it not been low water all the people of the settlement would have been lost. The tides rise and fall about fourteen feet. Capt. Sands, who was at English harbor, states that if there were plenty of water in the line of rupture of the mountain, it would be possible for a vessel to sail through. Capt. Culkie, of the schooner *Kodiak*, who approached St. Augustin on Nov. 10th, found a new island about a mile and a-half long and seventy-five feet high, that had been upheaved in the ten-fathom passage between the island and the mainland. At the same time two extinct volcanoes on the Alaskan peninsula, reported to be about west from the active volcano Iliamna (12,000 feet high), burst into activity. A party of Aleuts, living on the island, are supposed to be lost.

The Arctic.—*Novaya Zemlya.*—M. Grinevetsky, who journeyed across Novaya Zemlya in the spring of 1878, reports that the southern island consists of three different parts. The northern part is covered by mountains that are quite unknown, and is bounded to the south by the Pakhovaya river; the middle part is covered, on the west coast, by five or six parallel chains of hills, the highest summits of which reach 800 feet, while to the east is a wide plateau; and the southern part is a plateau not more than 450 feet high. There are two varieties of reindeer on the islands, one confined to the southern, the other to the northern island, and the latter variety greatly resembles the reindeer of Spitzbergen. This fact, taken with the feebleness of the cold sea current in Barentz sea, and the large amount of mud and gravel on the floating ice north-west of Novaya Zemlya, gives rise to the idea that Spitzbergen is connected with Novaya Zemlya by an archipelago.

The Archipelago of Cape Horn.—The French expedition has been actively engaged in surveying the coasts of this group of islands, which extend south of Beagle strait about 58° S. lat. These islands present the same structure as the continent of which they are the continuation. Off their western coast is an

almost continuous chain of islets and detached rocks, separated from the coast by intricate and deep canals. The western coast itself is a line of snow-covered mountains, while the eastern parts of the islands, comparatively flat and of Tertiary formation, recall the pampas of the continent.

It has been found that existing maps are in error in many points. The west coast only of Hoste island had previously been delineated, but now the entire contour is known. New Year sound, a great bay filled with islets and ending in four great arms, and the strait between Pothuau and Jaureguiberry islands have been fixed with precision, and the coast line of Wollaston group, composed of the three large islands, Grevy, Bayly and Wollaston, has been determined.

The islands consist of peninsulas joined to each other by narrow low isthmuses. Between these peninsulas run deep fjords, often terminating in glaciers that descend to the sea. Ponsonby sound, the largest of these fjords, penetrates twenty-eight miles into the interior of Hoste island.

GEOGRAPHICAL NOTES.—Professor Hall has made a complete survey of the Waddy Arabah and the Dead sea, with a traverse across Southern Palestine. Akabah was laid down too far south, and the south part of the Dead sea, as shown on the maps, is quite out of its true shape and position. The Lisan has to be shifted three miles.——Mr. Wilfred Powell, with four or five Europeans, including a naturalist and a geologist, will leave England about the beginning of March to explore New Guinea. The intention is to proceed in a steam launch up the Ambernoli river, on the north coast, and then proceed southwards to Astrolobe bay. ——The region of the Pamir has now been thoroughly explored by Dr. Regel and his companions. The valley of the Panj and its tributaries, as far south as Sist (37° N. lat.) and east to Shakddere (72° 50′ E. long.), has been followed up, and an immense bend of this river to the west, due to a high chain of mountains, and a wide lake, Shiva, 11,000 feet above the sea, to the west of this bend, will considerably modify the maps of the west of this region. The great Pamir chain has been crossed in four places, and the whole region has been covered with a network of surveys.——A letter from Dr. Rich. Böhm, dated July, 1883, shows that he and his companion, Paul Reichardt, have settled for awhile at Qua Mpara, on the western shore of Tanganyika.——Mr. Thonar has entertained the Geographical Society of Paris with an account of his search for the remains of the Crevaux mission. Crevaux and his companions were murdered by the Tobas in retaliation for an attack made upon them by the people of Caiza. The victims were killed upon the identical spot where, a few days before, ten or twelve Indians had been killed. Haurat and Blanco, who escaped massacre by swimming the river, were afterwards taken, and died after six months of

captivity and suffering. Ceballos, the sole survivor, was a prisoner for five months. M. Thonar, with his party, visited the scene of the massacre and traversed the mysterious regions of the Chaco with only the loss of a single man, spite of the hostile attitude of the Indians.——Mr. Chas. Winnieke has succeeded in exploring and mapping about 40,000 square miles of previously unknown country in Australia. Distances of from 200 to 300 miles had to be traversed across the highest sand ridges before water could be obtained.——Mr. O'Neill, who arrived at Mozambique Feb. 4, after having traversed 1400 miles of unexplored country between that place and Lake Nyassa, has discovered Lake Amarambu, the existence of which was previously unknown. He reports Lake Shirwa to be smaller than has been represented. On his return he followed the Likelungo valley, which he found to be well peopled.

GEOLOGY AND PALÆONTOLOGY.

THE MASTODONS OF NORTH AMERICA.—There are probably nine species of the genus Mastodon which may be clearly distinguished as former inhabitants of North America. The genus first appears in the Ticholeptus beds and continues to, if not into, the human period. The statement that this genus occurs in the White River formation is erroneous.[1] The oldest species is probably the *M. proavus* Cope. The Loup Fork epoch contains the remains of eight of the nine species, while one only, the *M. ohioticus* Cuv., is characteristic of later ages.

The following table expresses the characters of these species in analytical form:

I. Intermediate molars with not more than three crests.

α. Crests acute, transverse.

β. Valleys uninterrupted.

Last superior molar with three crests and a heel; crests low not serrate . . *M. [illegible]*
Last superior molar with four crests and a heel; crests elevated not serrate . . *M. ohioticus.*

ββ. Valleys interrupted.

Edge of crest tuberculate . . . . . *M. serridens*

αα. Crests transverse, composed of conic lobes.

β. Valleys ? uninterrupted.

Last inferior molar narrow, with four crests; no accessory tubercles . . . *M. shepardi.*

β. Valleys interrupted.

Last inferior molar with four crests and a heel; symphysis short, M. .150; smaller size . . . . . *M. cuhyi[illegible]*
Last inferior molar with four crests and a cingulum; symphysis longer, M. .250; size medium . . . . . *M. [illegible]*
Last inferior molar with five crests and a heel; symphysis very long, M. .450; size largest . . . . . *M. angustidens*

" *αα*. Crests broken into conic lobes; those of opposite sides alternating.

Last inferior molar narrow, supporting four crests and a heel . . . . . *M. obscurus*

[1] See Report of the U. S. Geological Survey of the 40th parallel, Vol. I, p. 412.

II. Intermediate molars with four transverse crests.

A long symphysis; crests well separated, tubercular, with accessory lobes interrupting valleys ..... *M. campester.*

Symphysis very short; crests thick, closing valleys by contact; no accessory cusps; (Leidy)..... *M. mirificus.*

The following notes may be made on these species:

M. proavus Cope.—The two crested molars of this species are nearly twice as large as those of *M. ohioticus*, leading to the supposition that some of them may belong to the "intermediate" series. This is confirmed by the small number of crests of the last superior molar of an individual from the Ticholeptus beds, which has only three crests and a heel. This molar is a good deal like the corresponding one of the *M. borsoni*, figured and described by Vacek, but differs in the smaller number of crests and in the expansion of the inner base of the external half of each crest, which thus gives a triangular section on wearing. A femur indicates that this is one of the largest species of the genus.

M. ohioticus Cuv.—Probably a descendant of the preceding, which represents it in earlier periods.

M. serridens Cope, sp. nov.—Founded on a first or second true molar from Texas. It is peculiar among American species in its acute elevated, entire crests, with tuberculo-serrate edges. It thus resembles the *M. turicensis*, but differs in well-developed longitudinal crests at the inner end of the external half of the crests, which consist of two tubercles on the posterior side of a crest, and on the anterior side of the next succeeding crest. Strong anterior and posterior cingula; edge of each cross-crest with six or seven tubercles. Length of crown, M. .130; width, .080; elevation, .061. Length of *M. ohioticus*, but narrower. Found by Henry Brous, M.D.

M. shepardi Leidy.—This species is apparently distinct from *M. obscurus* Leidy, but its distinction from *M. humboldti* has not yet been ascertained. California.

M. euhypodon Cope, sp. nov.—Founded on a nearly perfect left mandibular ramus with last molar tooth and tusk, with entire palate with both last molar teeth and tusks. The superior tusks are small and have an enamel band, and the inferior tusks are large and have an enamel band. Superior tusks compressed; inferior cylindric. The jaws indicate a small species, but the molar teeth are as large as those of the larger American form of *M. angustidens*, and as long as that of *M. ohioticus*, but narrower. Its symphysis is not prolonged. Length of ramus posterior to symphysis, M. .500; of last lower molar, .182; width of do., .75. The mental tusk is much larger than that of *M. productus* or *M. angustidens*. Diameter of its alveolus, .068. Kansas, Frank Hazard.

M. productus Cope.—Loup Fork Beds of New Mexico.

M. angustidens Cuv. var.—Lower jaws of four individuals, two of which are nearly complete, show that this species is found in

North America under a slight modification of form. The only difference between our specimens and those of Europe is the greater size of the heel of the second true molar, which is really tetralophodont. It is a larger species than the last two. The best preserved ramus measures M. 1 080 in length, of which .420 is symphysis. Loup Fork beds of Kansas, Nebraska and Dakota.

M. obscurus Leidy.—This species rests on a lower last molar of uncertain origin. Its relations have yet to be determined.

M. campester Cope.—This very distinct species was found in the Loup Fork beds of Kansas by Dr. R. S. Hill, and described by me in 1879, in the Proceeds. Amer. Philos. Soc.

M. mirificus Leidy.—From the Loup Fork beds of Nebraska, found by Dr. Hayden. Resembles most the *M. atticus* Wagn., in dentition.—*E. D. Cope.*

MARSH ON DIPLODOCUS.—In a late number of the *American Journal of Science and Arts*, Professor Marsh describes such parts of the osteology of the genus Diplodocus as are at his disposal. The genus is referred to the Dinosauria, where it enters the division Opisthocœla. It is remarkable in the position of the external nares, which are superior, and between the orbits. The muzzle is declivous in the typical species, *D. longus*, and the teeth are few and slender, and are confined to the anterior parts of the jaws, the maxillary bones bearing but few of them. Two species of the genus are described by Marsh, *D. longus* and *D. lacustris*. The former was probably forty or fifty feet in length.

Professor Marsh believes that the *Diplodocus longus* was a terrestrial animal, and lived on the foliage of forest trees. The character of the dentition indicates soft food, and one not requiring mastication. They might be described as a pair of opposed rakes, like oyster-tongs. The position of the nostrils above the orbits is eminently characteristic of aquatic, and especially of marine animals. It confirms the view I expressed in this journal a few years ago in describing the *Amphicœlias fragilissimus*, that the species of the Opisthocœla were aquatic, and walked on the bottom; their cavernous vertebræ, containing diverticular pneumatic floats, and their solid legs and tail acting as anchors.—*E. D. Cope.*

LITHOLOGY OF SOME CORDILLERIAN VOLCANOES.—A recent article by Messrs. Hague and Iddings (*Amer. Jour. Science and Arts*, September, 1883) gives the results of a study of the volcanic rocks of Lassen's peak, Mts. Shasta, Hood, and Rainier. These cones are andesitic volcanoes, with extrusions of basalt along the slopes and base, and the greatest similarity is said to exist in their lavas. The rocks are classified as basalt, hypersthene andesite, hornblende andesite, and dacite.

The basalt occurs as a light to dark gray rock, sometimes vesicular, and presents macroscopically only small olivine cry-

tals. Microscopically this rock is seen to be composed of ledge-formed plagioclase, irregular grains of light brownish-green augite, colorless olivine, magnetite, and glass. The hypersthene andesite is generally a porous, sometimes pumiceous, rock, varying in color from blue-black to steel-gray, but sometimes red or reddish-gray. Inclosed in the ground-mass are numerous porphyritic feldspar crystals, with some augite and hypersthene. Microscopically the rock is seen to be composed of plagioclase, augite, hypersthene, magnetite, and a glassy base sometimes globulitic, more often filled with microlites of feldspar and pyroxene, and magnetite grains. The hornblende andesite is arranged into two varieties: one near the hypersthene andesite, and resembling it in appearance and structure, but contains hornblende; the other consists chiefly of ledge-formed feldspars, minute pyroxenes, a little magnetite, with or without colorless glass, all inclosing porphyritic plagioclases and hornblendes.

The most interesting rock described is the dacite. This name is given to the rock styled by Richthofen, in 1867, *nevadite* or *granitic rhyolite*, of which Mr. C. King declared, in 1878, that it was "entirely made up of crystalline minerals, with only the slightest traces of vitreous binding material." He also classed it with the rhyolites. In 1881 the present writer pointed out that King was mistaken in his statements of the small amount of glass, and later referred the nevadite to the trachytes.

Hague and Iddings say that they can not regard the rock as in any sense entitled to be classed as a rhyolite, and that it is rich in a glassy base, so far agreeing with the present writer; but they class it under dacite (meaning a quartz-bearing andesite), a term of which he fails thus far to see any need in lithology. Our authors seem inclined to carry the term andesite in its subdivisions to the same extreme that Zabó does the word trachyte—a not unnatural proceeding on their part. The analyses that have been previously made indicate that nevadite belongs to the trachytes, instead of to the andesites. It is described by Messrs. Hague and Iddings as composed of a colorless glass full of gas cavities, through which are found relatively few microscopic crystals of plagioclase, hornblende, mica, pyroxene, magnetite, apatite and zircon, forming a ground-mass inclosing plagioclase, mica, hornblende and quartz, and rarely pyroxene.

The paper of Messrs. Hague and Iddings is in advance of the majority of lithological ones, inasmuch as it attempts to *describe the rocks*, and does not look upon them as small mineral cabinets, regarding which the observer has done his duty when he has described a few of the pretty minerals enclosed. Our authors find that all the above described rocks grade into one another—all possible forms existing between any two types—a view that, in the present writer's opinion, holds good for eruptive rocks of every age the world over. The distribution is given as follows:

Mt. Rainier.—Hypersthene andesite.

Mt. Hood.—Hypersthene and hornblende andesites.

Mt. Shasta.—Basalt, and hypersthene and hornblende andesites.

Lassen's Peak.—Basalt, hypersthene, hornblende, and quartz-bearing andesites (dacite or nevadite).

The paper, from the point of view of our authors and their method of study, is an excellent one, and they are to be congratulated on the results.—*M. E. Wadsworth.*

HEAT AND COLD IN GEOLOGY.—A change of a few degrees in temperature between summer and winter, across the face of a continent, will make a surface expansion and contraction of one mile, every year. This cannot go on forever as an irresistible force without making some permanent changes. It may only affect the upper stratas so much, and it may be relieved by fissures somewhat. But in time fissures may be obstructed, either by minerals deposited from water, or by other means, so something must give way. The upper strata may be gradually compressed, or may slip upon those below. Elevations may slowly rise, or insupportable tensions may occur, causing earthquakes, or even volcanic action.

A less continuous and more striking result may come from the emergence of large areas from the sea. The ocean bed, especially where covered by arctic currents, must be of low temperature to a very considerable depth. Shutting out the arctic current would raise the temperature, and elevation from the sea would permanently raise it from ten to thirty degrees to a great depth. This, however gradual, would produce an expansion which would be irresistible and certainly produce great permanent changes, such as bending and elevation of strata. The bending and elevation might be toward one or both margins, where the cold and less elastic sea bed gave fixed resistance to further movement. Perhaps the lines of elevation would be at right angles to the lines of thrust across broad plains of expansion, to which they might be slightly curved. Such forms are shown in many if not all mountain systems, as if to point to the source of the expansion thrusts producing them. Indeed, such systems may be traced over the globe in such order as to apparently indicate various further laws and considerations affecting the action of this cause. This is a force that has not been duly recognized, which must have produced elevatory and other changes in all geologic ages with inexorable iron grasp, while ice and winds and waves, and streams and sea have worn away. I present it for discussion.—*Sam'l F. Wallace, Keokuk, Iowa.*

GEOLOGICAL NOTES.—*General.*—The Geological Survey Map of England and Wales is now completed; that of Ireland will be finished in a few years; but that of Scotland is far from complete. The work was commenced by Hy. T. De la Beche, at his own expense, and it was through his efforts and tact that the Geologi-

cal Survey was organized, and the Geological Museum and School of Mines established.

Silurian.—In a specimen of Asaphus, from the Black Trenton Limestone, Dr. Hy. Woodward has discovered what he believes to be the jointed palpus of one of the maxillæ, in the same position as is occupied by that organ in Apus, Serolis, etc. There appear to be seven articulations in the palpus above the basal joint. He states his opinion that the trilobites should be placed near to, if not actually in, the Isopoda-Normalia (Geol. Mag., Feb.). Dr. I. Mickleborough follows this with an account of a specimen of *Asaphus megistos*, in which ten pairs of jointed limbs are clearly seen.——Dr. Reusch, in a volume recently published at Leipzig, describes the Silurian fossils found by him in highly altered rocks in the Bergen peninsula, Norway. The shells of the fossils have disappeared, and only a reddish colored earth remains; yet the trilobites, Phacops and Calymene, and the corals, Cyathophyllum, Halysites, etc., with some graptolites, can be identified.

Triassic.—Herr H. Kunisch describes and figures (Zeit. der Deutsch. Geol. Ges., 1883) the adult stage of *Encrinus gracilis* from the Muschelkalk; and in a succeeding paper, Herr K. Picard describes and figures *Encrinus Beyrichii*, a new species from the Muschelkalk, near Sondershausen. All the joints of the stalk are pentagonal.——At a recent meeting of the Geological Society of London, Professor Owen described the skull and dentition of *Tritylodon longævus*, from South Africa. The teeth resemble those of *Microlestes*, from the Keuper of Würtemberg, and those of *Stereognathus*, from the Oölite.

Jurassic.—W. H. Hudleston (Geol. Mag., Feb., 1884) contributes some notes upon the Gasteropoda of the Oxfordian and Lower Oölites, and describes four new species of Cerithium.——Professor Owen, at a recent meeting of the Geological Society of London, separated the Kimmeridgian *Plesiosuchus Mantelii* from the genus Steneosaurus, on account of certain peculiarities in the skull, teeth and vertebræ. It approaches nearer to the recent crocodiles than the older oölitic type.——J. W. Judd (*Nature*, Feb. 7) notes the undoubted occurrence, in a well bored at Richmond (Surrey, England), of a stratum of oölitic limestone eighty-seven and a half feet thick, with some subordinate clay bands, one of which was crowded with fossils of the age of the Great Oölite. Sandstone, evidently triassic, occurred under this stratum, and pebbles of Coal-measure sandstone, with fragments of anthracite, seem to indicate the presence of an anthracite bed below. The Jurassic and Triassic have never before been certainly identified as present below London, but this discovery shows that some anomalous strata found in other borings were really Jurassic.

Tertiary.—Herr W. Dames (Zeit. des Deutsch. Geol. Ges., 1883) describes *Cervus pentelici* and *Mus Gaudryi*, from the pliocene of Pikermi in Attica.——Restorations of the crocodilian *Diplocyno-*

don ratelii, and the turtle *Ptygogaster emydoides*, have been made for the museum of the Academy of Sciences of Paris. The remains from which the restorations have been made were put aside eighteen years ago by M. A. Milne Edwards, when he wrote his great work on fossil birds, and were taken, like most of M. Edwards' material, from the lower miocene of Saint-Gerand-le-Puy (Allier). Notwithstanding the smallness and great number of the pieces, M. Fischer has succeeded in joining together the head, all the vertebræ, some ribs, most of the members, and a great part of the bony plates of Diplocynodon, which M. Vaillant believes to be nearly related to Jacare.——In the Bulletin de la Société Geologique de France, Dr. Lemoine describes two casts of the brain mould of the crocodile *Thoracosaurus macrorhynchus*. These remarkable specimens are much like corresponding casts of the modern gavial, but present relatively rather smaller cerebral hemispheres.

Recent.—Herr D. Brauns (Zeit. des Deutsch. Geol. Ges., 1883) describes the diluvial mammals of Japan, and arrives at the conclusion that the geology, flora, pliocene molluscan fauna, and fossil land-fauna of Japan, prove that that country is most intimately connected with the Palæarctic region, and that it is only very recently that it has become a disrupted portion of the Eastern continent.

BOTANY.[1]

An enormous Puff-ball.—My friend, Professor R. E. Call, has handed me a photograph of a puff-ball, the largest on record. The fungus was found by him in Herkimer county, N. Y., in 1877, and as it was impossible to preserve it, careful measurements were made, and photographs of it were taken. It was irregularly oval in outline, and much flattened, instead of approaching the spherical form, as is common in the large puff-balls. Its largest diameter was *five feet and four inches*, its smallest *four feet and six inches*, while its height was but nine and a-half inches. In referring to it Professor Call described it as "much larger than the largest wash-tub we had at home."

The specimen undoubtedly belonged to the species known as the giant puff-ball (*Lycoperdon giganteum*), and it was by far the largest of any of which I have been able to find measurements.—*C. E. Bessey.*

Notes on Fungi.—Among the more interesting fungi are some of the various forms embraced in the genus Polyporus, of which over 1000 species have been described. The species of this genus are not as numerous as those of the genus Agaricus, of which the common mushroom is a well-known type, but they are not less interesting in the great variety of the forms they assume and in the universality of their diffusion. The Polypori most commonly noticed are probably those growing on dead trees or logs.

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

and standing out from the trunk or log like the front piece of a cap, and varying in size from one inch to two feet across, and varying in texture from a soft, juicy, fleshy substance, which decays almost as soon as it has finished its growth, to the hard, woody or corky species that endure for several years, and before the introduction of lucifer matches, furnished the tinder to catch the spark from the flint and steel. If one of these Polypori that grow on trunks of trees is carefully examined, it will be seen that the under side is full of small holes, which are really the mouths of closely-packed tubes extending up for some distance and forming no inconsiderable part of the entire mass. These tubes or pores are always present in every Polyporus, and form the distinctive character of the genus, as is indicated by the word itself—polyporus signifying *many pores*. These tubes or pores vary considerably in size, but are always small, often finer than a cambric needle and not generally larger than a common pin. Their arrangement and appearance is like that of the cells in a honeycomb, and like these they are often more or less angular though normally cylindrical. This system of pores constitutes the *hymenium* in which the seeds, or *spores* as they are called, are produced. When examined with the microscope the inner surface of these tubes is found to be studded with little cylindrical projections, from the rounded apices of which arise generally four short, straight, transparent horns, each bearing at its tip a single minute, globose or oval spore. These spores soon fall from the points of their attachment, out of the tubes in which they grew, in such quantities as to give their own color to any object on which they chance to fall—generally white or rust color—always the same in the same species; the color of the spores, however, in Polypori does not appear to present as great a variety of shades as among the Agarics, but this may be because in the Polypori the color of the spores is not as readily seen, as from some cause they do not appear to be as readily and as copiously discharged as in the Agarics. Another peculiarity of the genus Polyporus is, that the direction of the pores is always *down*, so that in *resupinate* forms on a vertical surface, *i. e.*, on the side of a tree or log, the *sides* of the pores are exposed instead of their mouths. This downward tendency is finely illustrated in a specimen of *Polyporus igniarius*, which I lately found on the trunk of a dead oak that had fallen and lodged on another tree at an angle of about 45°. The Polyporus had commenced its growth while the trunk was standing, and had continued to grow after the trunk had fallen, as was apparent from a bend or angle of about 45° about midway in the length of the pores, so as to continue their growth directly downwards.—*J. B. Ellis, Newfield, N. J.*

Cross-fertilization in Lobelia, &c.—E. Haviland, in Proc. Linn. Soc. N. S. Wales, VIII, pp. 182–86, describes the development of the stamens and pistil in species of Lobelia. The anthers

are closely united in a cylinder. The pollen is shed inside and pushed out by the hairs on the growing style. After the pollen has withered, the apex of the style splits and expands its lobes. The writer considers that cross-fertilization is the almost invariable rule. He also notes (p. 289) the contrivances for cross-fertilization in Leptospermum, a genus of Australian shrubs.—*J. F. J.*

WATER FROM EUCALYPTUS ROOTS.—In many parts of Australia, where water is scarce, the natives formerly procured it from the roots of the Eucalyptus and a few other trees. The tree most preferred throws out numerous lateral roots, which lie at a depth of from six to twelve inches below the surface. According to a writer in the Proc. Linn. Soc. of N. South Wales (Vol. VIII, 1883), the native having ascertained, by means of prodding with a pointed stick or spear, the position of some of the roots, "removes the superincumbent soil with his wooden shovel for twenty or thirty feet, and cutting the root off at each end lifts it out of the trench and cuts it up into lengths of about eighteen inches or two feet, knocks off the bark and stands the several portions on end in some receptacle to contain the water. * * * As soon as these pieces are placed on end, the water commences to drip, and when the whole of the root or roots are cut up and placed on end, the native, beginning at the first placed, puts the end in his mouth and by a vigorous puff expels the remaining water. * * The water is beautifully clear, cool and free from any unpleasant taste or smell."—*J. F. J.*

STURTEVANT'S STUDIES OF MAIZE.—In a privately distributed pamphlet, just received, Dr. Sturtevant, the director of the N. Y. Agricultural Experiment Station, sets forth the results of some of his studies of the varieties of maize. A large number of excellent cuts enable the reader to obtain clear ideas respecting the structure of the mature kernels. An attempt is made to classify the varieties, and there appears to be some ground for hoping that it will not be unsuccessful. From a careful study of many kinds of maize, grown upon the grounds of the experimental station, Dr. Sturtevant is led to the conclusion that at least five well-marked species may be recognized. At present he denominates these agricultural species, and distinguishes them from the species of systematic botany by a star (*) placed between the generic and specific names.

These species are as follows:

1. *Zea * everta*, the pop corns.
2. *Zea * indurata*, the flint corns.
3. *Zea * indentata*, the dent corns.
4. *Zea * amylacea*, the soft corns.
5. *Zea * saccharata*, the sweet corns.

In the foregoing, if the kernels be split parallel to the embryo the pop corns show only a corneous endosperm; in the flint corns a corneous belt surrounds an interior softer tissue; in the dent

corns the softer tissue extends to the apex of the kernel, and is bounded by a column of corneous tissue on each side; the soft corns have no corneous tissue; while the sweet corns are composed of a translucent and more or less shriveled corneous matter.

Each of these species is divisible into several sub-species or races, which exhibit remarkable permanence. In fact, one of the unlooked-for facts brought out by these observations of Dr. Sturtevant, is the permanence of the several types, whether of species or races, as indicated below.

The following general conclusions are recorded:

"Cross-fertilization of the current year is manifested on the kernel and not on the ear, and this influence is not reciprocally strong as between the races [species] or even the sub-races, and the resistance to current hybridization is more strongly marked in some races [species], sub-races or varieties than in others.

"Hybridization in the seed used produces a variety of ears, but each ear in general is quite close to one of the parent types; an intermixture of kernel in no case seems to be produced. Reciprocal fertilization between two races [species] does not seem to be productive of equal effect."

CURTISS' SEVENTH FASCICLE OF NORTH AMERICAN PLANTS.—This welcome package, with its fine specimens, was distributed to botanists in February. Like its predecessors it contains many species of great interest, especially to Northern collectors. Most of the NATURALIST readers are aware that Mr. Curtiss has been collecting for many years in Florida, and that his specimens have found their way into most of the great herbaria of this country and Europe.

ANOTHER BOTANY.—Some time ago our attention was called to another text-book of Botany, prepared by Dr. Kellerman, and brought out by the house of Potter & Co. of Philadelphia. We hoped for the sake of the younger botanical writers to be able to commend this effort of a new author, but candor and a consideration for the readers of the NATURALIST compel us to say that the work has been poorly done. Naturally the book is a compilation, but this has been, as it appears to us, unwisely and injudiciously done. Parts I, II and III contain numerous cuts, definitions and expressions which have evidently been boldly copied from well-known text-books without the remotest acknowledgment. However, had this questionable method of compilation given us a reliable text-book, the pupils in the schools would have had no reason for complaining; but, as is inevitable in such book making, the several parts so brought together do not fit well; hence, we find statements in one part contradicted in another. The announcement is made on page 4 that the author has in preparation a manual of the wild flowers of the northern United

States, a field now occupied by Dr. Gray's and Professor Wood's manuals. It is to be hoped that Dr. Kellerman's second book will be a less verbatim compilation than his first has been.

Botanical Notes.—We have examined Professor Groff's Plant Analysis, published by the Science and Health Publishing Company of Lewisburg, Pa., and can commend it to those who wish a cheap and yet good help of this kind.——Dr. Farlow, in the March *Botanical Gazette*, makes a number of interesting additions to his previous list of Peronosporeæ.——In a recent number of *Nature*, Dr. Schweinfurth contributes an interesting paper on the flora of ancient Egypt. As is well known, the funeral wreaths preserved in the mummy cases have been objects of study by botanists for some time, and through these we now know much as to the common plants of the Nile region thirty to thirty-five centuries ago. The evidence as obtained shows that some important migrations have taken place during the time which has elapsed since the wreaths were gathered. On the other hand, there is evidence that some plants have, through this long period, preserved not only their places in the flora, but their specific and varietal characters as well.——The last part (No. 7, Algæ) of the new edition of Rabenhorst's Kryptogamen Flora brings Dr. Hauck's work up to the Phæozoösporeæ.——It gives us great pleasure to learn that the New York Agricultural Experiment Station has secured the services of Professor J. C. Arthur, who is to be the station botanist. The director of the station is to be congratulated upon his wise selection, which is an indication that *plant life*, rather than *plant names*, shall receive the greatest attention of the station.——Thomas Hick, in the March *Journal of Botany*, concludes his paper on protoplasmic continuity in the Florideæ. He says in conclusion, after having examined many species of widely different genera, "It seems clear that, if not universal, protoplasmic continuity is very widely distributed in the Florideæ," and further on, in explanation of this phenomenon, "The process of cell-division appears never to proceed so far as to completely separate the different portions of a divided protoplasmic body, so that they remain connected together by one or more threads of protoplasmic material."

ENTOMOLOGY.

Gills of Insect Larvæ.—In an article on this subject in *Psyche* (IV, 110, 1883), Professor G. Macloskie states that it is usual to describe the laminæ of the pneumatic gills as containing systems of fine tracheal loops, somewhat after the pattern of a plurality of carbon-wicks in an Edison lamp. In a specimen, however, of the rectal branchiæ of the larval Libellula, which he rolled under the cover-glass, he found that the multitude of tracheal ramifications ended cœcally; all were of about the same

length, their extremities recurved within the containing sac, and their tips not at all swollen, but rounded off. "As they are elastic, and the closing sac distensible, we think it highly probable that with each water-inspiration the sacs enlarge and the tracheal spray (having air forced in by the forward compression of the large tracheæ) spreads out so as to bring the full tide of air close to the tide of water. Léon Dufour, seems to have had some process like this in view, when he said that each lamella of the branchia of Potamophilus is 'probably swollen during life by air transmitted by endosmosis.' As we understand the case, the air is injected into the branchiæ from the rest of the body by rhythmical contractions, and its gases then communicate endosmotically with those in the tidal waters, so as to secure renovation." The action of the tracheæ, Macloskie believes to be tidal rather than due to peripheral capillary circulation; there being a flux and reflux, rather than a mere circulation of the air.

The Closed Poison Glands of Caterpillars.—Dr. Dimmock, in the course of a valuable article "on some glands which open externally on insects," in *Psyche*, for "Sept., Oct., 1882" (published in Feb., 1884!), states, that if a Cecropia caterpillar "be examined carefully, the black spines upon its red, blue, and yellow knobs, or tubercles, will be seen to break easily from the tubercles, and a clear, yellow fluid of disagreeable odor to ooze from each opening left by the injury. By crushing the tubercle with a pair of forceps, the same strong odor is very noticeable, and by this mode of treatment one has no difficulty in proving that each tubercle, small or large, blue, yellow, or red, contains the odorous fluid. The red tubercles are seen, in sections cut with the microtome, to be divided into compartments, the cavities of each spine opening into a compartment at its basal end. The spines themselves are quite rigid and very brittle, so that they break away at a slight touch and leave a hole in the tubercle, out of which the odorous fluid pours, pushed by internal pressure. This fluid, which I have not examined carefully, but which I hope later to study chemically, is strongly acid to litmus paper, but causes a purple precipitate in carmine solution." The odor given out by these glands suggests at once their protective function. Similar glands, *i.e.* with no outlet until one is produced by external agency, are not rare in Bombycid larvæ. Karsten, in 1848, described the anatomy of the poison glands at the base of the hairs of an American Saturnia. The secretion is "perhaps formic acid or a formate in solution." The paper is crammed with interesting facts on this subject. Among others it is stated that, according to Witlaczil, the "honey" secreted by the Aphides issues from the anus and not from the tubes on the sixth segment.

Thoracic Musculature of Insects.—C. Luks has investigated the thoracic musculature of insects of every group, except

the Thysanura and Collembola. He finds, according to the Journal of the Royal Microscopical Society, that the wing-muscles appear to have developed along two lines; in one, the indirect flying muscles were almost completely aborted, while in the other they were developed at the expense of the direct muscles. In close connection with the development and modification of these muscles is the extent of concentration of the rings of the thorax and the size of the wings. In the Orthoptera all the three segments of the thorax are freely movable on one another, while in the Coleoptera only the prothorax is so movable. In the Lepidoptera the prothorax loses its mobility, though retaining its distinctness, while in the Diptera and Hymenoptera the whole region is converted into a firm thoracic apparatus, to which, in the latter, the first abdominal segment also becomes applied. As Graber has shown, we observe that in insects which by other points in their organization intimate that they are more highly developed, one pair of wings tends to become aborted, as is seen in the Coleoptera, Diptera, and even Lepidoptera, where the hinder pair of wings often become united with and share in the movement of the anterior pair.

Respiratory Center of Insects. — According to Donhoff, the respiratory center in the bee is situated in the anterior ganglia, and therefore the respiratory movements are put an end to by decapitation. Dr. O. Langendorff, from his investigation, finds that in the bee, wasp, and other insects, the respiratory movements are not destroyed by removal of the head, especially when by *tearing*, and not *cutting* it off, a great loss of blood is avoided, the respiratory movements show the same increased rapidity with a high temperature, slowing with a low temperature in the headless insect as in the uninjured insect.

A number of experiments were also made upon *Libellula depressa* and other insects belonging to the Pseudoneuroptera, in which group the segmentation of the body is very marked in correspondence with their ancestral type; in these insects the respiratory center is not merely not localized in the head, but each segment is a complete center in itself, being capable of respiratory movement, when entirely isolated. "A better example to illustrate the physiological metamerism of the insect body can hardly be imagined; each segment with its ganglion is a physiological unity!" The results of a great number of observations are fully stated in the paper, and several diagrams are given of tracings obtained of the respiratory movements.—*Journ. Roy. Mic. Society, February.*

Mouth-parts of the Hemiptera.—O. Geise regards the flattened or more or less curved process of the clypeus of the Rynchota as the homologue of the labrum of beetles; the jointed groove corresponds to the labium, the two separable setæ to the

mandibles, and the two setæ, only with difficulty separable, to the maxillæ of biting insects. He next considers the structure which Savigny regarded as the lingula, but to which most authors have applied Burmeister's name of "Wanzen-platte;" he himself proposes to speak of it as the pharynx, and describes it as being endowed with great elasticity, and as acting as a pump, which is set in action by the contraction of muscles attached to the body-wall, whereby the space in the walls in which they are inserted is enlarged, and a vacuum thereby formed. The structure and relations of these parts are entered into in great detail, but, says the Journal of the Royal Microscopical Society, a full abstract of the paper would be impossible without a republication of the figures to which constant reference is made. The essay should receive the careful study of students of the anatomy of insects.

Chlorophyll in Aphides.—L. Macchiati, having noticed that certain Aphides, when placed in a dark situation, lost their color in the same way that leaves do, investigated two species, *Siphonophora malvæ* and *S. rosæ*, with a view of ascertaining whether they contained chlorophyll; he discovered, by applying the usual test, that chlorophyll was undoubtedly present. The objection that this substance is absorbed from plants by the insects, and not elaborated in their own bodies, is met by the statement that it is also to be found in those species that live upon the colored petals of flowers. The conclusion arrived at needs to be confirmed "by a more matured study," and M. Macchiati promises a fuller investigation of this interesting discovery.—*Journal of the Royal Microscopical Society.*

Ayers' Development of Œcanthus niveus and its Parasite, Teleas.—This is an extended, thorough, and well illustrated memoir on the embryology of the tree cricket, and its egg parasite, by Howard Ayers, a student of Professor E. L. Mark, at Cambridge, Mass. It received the Walker prize of the Boston Society of Natural History, in whose memoirs it appears, under date of January, 1884, forming a brochure of 56 pages, with eight plates and woodcuts in the text. Mr. Ayers endeavors to establish the following points in the embryology of Œcanthus:

1. The origin of the ovum in a germarium rather than from an ovarian epithelium.

2. The process of yolk formation by cell-degeneration instead of secretion.

3. The occurrence of a primitive segmentation of the embryo before the appearance of the permanent segments.

4. The existence of a pair of appendages (some of them rudimentary [deciduous]) on each of the seventeen segments of the body.

5. The origin of the dorsal vessel as a paired organ, the lateral halves of which fuse and give rise to a median tube in the same

manner as in some of the worms, and the origin of the blood corpuscles as nucleoli of endodermic cells.

6. The existence of embryonic gills.

7. The lack of any sharp distinction between a cell and its nucleus, and between a nucleus and its nucleolus.

8. The existence of segmental enlargements of the mesodermic somites, similar to those from which the nephridia of worms take their origin.

9. The origin and significance of the embryonal membranes among the insecta.

10. The origin and significance of the dorsal organ among the insecta.

Among the chief points of interest is the mode of formation of the blastoderm. No nucleus was observed in the fertilized eggs, even in those which had been only laid from one to twenty-five minutes; and in the ovarian egg after the disappearance of the germinative vesicle no traces of nuclei were to be found. When the blastoderm is partially formed, however, there are always numerous amœboid cells to be found throughout the yolk. These nuclei form the blastoderm in the following manner: the pseudopod-like processes sent out by a few of those migrating to the surface of the yolk fuse together, and furnish by rapid division a sufficient number of cells to form the blastodermic membrane. This mode is the same as observed by Bobretsky in the Lepidoptera. There is no segmentation of the yolk.

The fact that at first the embryo is composed of four well-marked regions, which the author designates as the "cephalic, maxillary, thoracic, and abdominal," is interesting. The author does not attempt to compare this feature with the earliest stage of the spider with its protozonites, as discovered by Claparede, but the resemblance is at least a striking one.

The process of turning of the embryo is clearly described and figured. After giving a summary of the development, attention is next directed to the mode of formation of the different organs. The novel points worked out are the origin of the heart and the discovery of so-called gills, and the relations of the germinal layers.

The formation of the heart begins after the revolution of the embryo; it is first to be distinguished in the abdominal region about the time of the closure of the dorsal ectoderm. "In the formation of the heart, the lateral plates of mesoderm grow upward around the mesenteron, and as their edges approach the median dorsal line there is seen to be in each a tube. These two plates coalesce in the median line, and their tubes unite into one—the heart, or dorsal vessel."

The discovery of the "gills or respiratory organs" which Mr. Ayers describes is rather startling. A pair of lateral outgrowths arise from the ectoderm of the pleural region of the first abdominal

segment, and "come to lie just behind but dorsad of the base of the third thoracic appendage." The internal cavities of each gill "are continuous with the body-cavity, and probably serve as channels through which the vascular fluid circulates." In sections of the gill-organ before becoming atrophied or absorbed, both distinct canals and lacunar spaces radiate from the point of connection of the pad with the body; "and these, together with the arrangement of the cells, give the radiate structure characteristic of the fresh gill." "The gill pad is essentially a single-layered sac, with a much constricted neck, evaginated from the pleural region of the abdomen." It should be observed that these are not tracheate gills, as they contain no tracheæ. Mr. Ayres does not speculate as to their origin.

While not accepting Balfour's interpretations and general conclusions as to the origin and significance of the primitive germinal layers among the insecta, Mr. Ayers confesses himself still in doubt as to their origin. But, he adds, "when we consider the rôle and subsequent fate of these two layers, it at once becomes apparent that such a view does not accord with the facts, for the blastoderm ultimately forms the entoderm (mesenteron), and the ectoderm, arising from a small area of thickened cells on one side of the blastoderm, encloses the yolk and endoderm by a genuine epiboly." With some hesitancy he then proposes an explanation which may apply to the Orthoptera: "How did the embryonic membranes (amnion and serosa) arise? What is their function? Is their present function the primitive one? The answer to these inquiries undoubtedly lies in the clear comprehension of the relations of the embryo to its food supply—the yolk. That the cellular embryonic membranes could have originated for protection, or from an early ecdysis, is, to say the least, highly improbable. Among the insecta the egg is furnished with a *protective membrane*—usually in the form of a chorion—before leaving the body of the parent. Omitting the interesting and original explanation in full, the result is that "in Œcanthus the membranes fuse at or near the head, and by a self-eversion through the opening caused by their rupture the embryo comes to lie outside of the amnion and serosa. The latter now forms a yolk sac, which, by a gradual contraction, as the yolk is absorbed, comes to lie within the body, being last seen just back of the head. It is always in connection with the mesenteron, and its thick walls finally disappear by a process of disintegration." The author thinks that in many, if not all, insects, the serosa and amnion play the same rôle that they do in Œcanthus, *i. e.*, "the serosa functions as a yolk sac, while the amnion is the dorsal wall of the insect. Hence the so-called dorsal organ is but the remnant of the yolk sac."

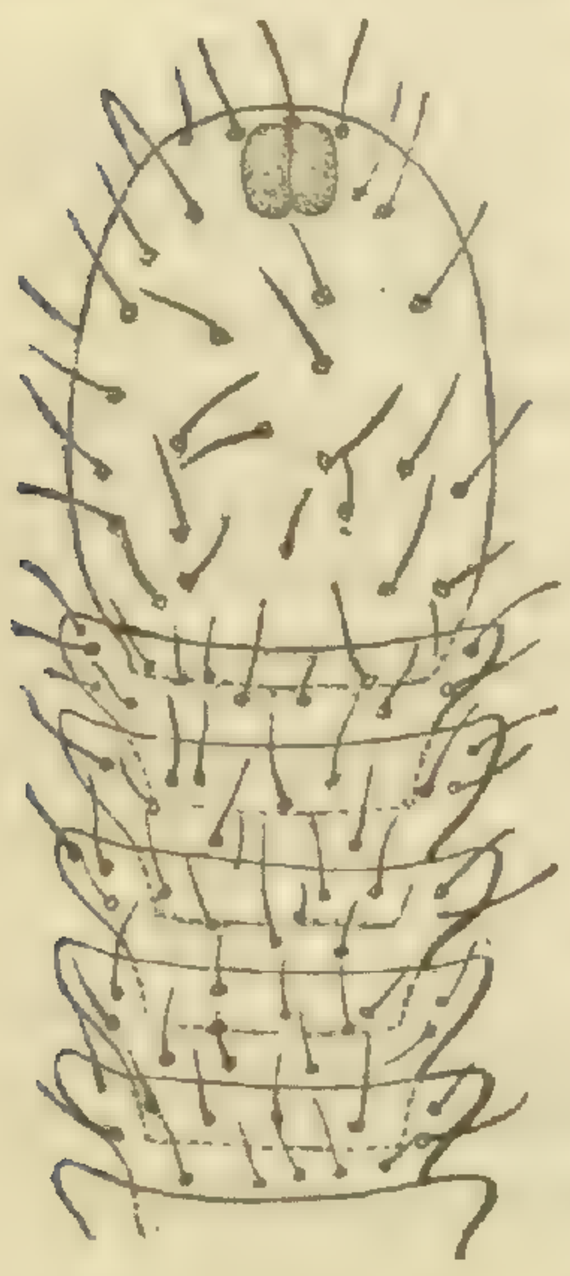
It is interesting to compare the history and function of the serosa and amnion in two branchiate Arthropoda (Limulus and Apus), in which, Limulus at least, the serosa does actually become

what we have called a "vicarious chorion," and after the chorion or egg-shell splits, becomes a protective membrane.[1]

Mr. Ayers' observations on the egg-parasite, Teleas, are full and valuable, showing, as he claims, the absence of embryonic membranes, and the occurrence of a larval form intermediate between the blastosphere and the cyclops larva of Ganin.

The illustrations are admirably clear, but the plates are too much crowded; this, however, is not the fault of the author.

A Possible Sense Organ in Campodea.—Several years ago, when studying Campodea, I found on the terminal joint of the antennæ what may prove to be a possible sense organ. On the tip of this joint is a body closely resembling a couple of beans placed side by side and supplied by the tip of the antennal nerve. The general relations are shown in the accompanying figure. I regret that I have no further observations which would tend to show the histology or functions of this organ. I mention it at this time to call the attention of others to it, in the hope that our knowledge of it may be increased.



My reason for supposing it a sense organ are the way in which it is supplied with nerves and also its general resemblance to what Dr. Packard has considered as sense organs in the caudal stylets of Chrysopila and the palpi of Perla.

A further feature which may here be mentioned is the power which Campodea has of retracting its antennæ. Ordinarily they are extended to their full length, and then present a moniliform appearance. The insect can, however, by the action of appropriate muscles, so draw the joints into each other that they present the appearance shown in my figure. I have noticed a similar capacity in Scolopendrella.—*J. S. Kingsley, in Science Record.*

Lucilia macellaria infesting Man.—A farmer's wife, thirty-five years of age, was attacked on Monday, September 27, 1875, with a headache and a flushed face. She stayed at work, expecting a malarial chill, an affection prevailing at that time in the neighborhood. From this time the pains in the region of the frontal cavity, at the base of the nose and below the eye, extending to the right ear, increased. At times the pain was more severe than at others, but it never entirely left. This pain was described as preventing hearing and breathing, and so excruciating that at intervals, day and night, her cries could be heard at a great distance from the house. Tuesday evening blood mucus began to run from the right nostril, which was somewhat swollen.

[1] See The Development of Limulus polyphemus. By A. S. Packard, Jr. Mem. Bost. Soc. Nat. Hist., March, 1872, p. 160, 161.

the swelling extending on Tuesday over the whole right side of the face. On this day, the fifth of the complaint, four large maggots dropped out of the right nostril. When I was first called to the patient, Monday, October 4, only the right lip and nostril were swollen, the acrid discharge having somewhat blistered the lips below. After each discharge the maggots dropped from the nostril, until the twelfth day; one hundred and forty or more maggots having escaped. The majority of the maggots were three-fourths of an inch in length, there being only a few which seemed a line or two shorter; they were of a yellow hue, conical shape, and having attached to one end two horn-like hooks. The patient recovered fully.

Monday, September 18, 1882, I saw a patient in the same neighborhood as the first, suffering from the same malady. At that time two hundred and eighty maggots had been discharged, and at the close of the illness, over three hundred. There was a swelling on each side of the nose, with a small opening to each. I lanced these openings, and more maggots came out.

In the Indian Territory the so-called screw-fly laid its eggs in the nose of man. In 1847, I heard of several deaths of men and children in Texas, near Dallas. The gad-fly was common in the American bottom forty years ago. It laid its eggs in the noses of cattle, and in the ears of horses and deer, but never in the human nose. The fly that I send is about four times as large as the common fly. Head a dark, glistening green; a bronze face, very lively in appearance. Is it the same that they called in Texas or Indian Territory the screw-fly? or is it the gad-fly seeking a new field?

The patient of 1875 is now alive and well. The second case occurred two years ago, near Collinsville, in this country, and proved fatal. The third patient, above named, is getting well. The fourth is reported from Georgia; the patient died.

The first case which I had in my charge was the first which ever occurred here. The eggs must have been deposited in the nose several days before the fifth, the day the maggots dropped out. On the eleventh day all were discharged. I secured live maggots at that time, September 18, 1882. I put soil in an open-mouthed vial and dropped the maggots on it; they crawled in the ground in about five minutes. I covered the opening with white damastis, and hoped that the next year the fly would come out of the ground. But on October 6, or the twentieth day, the vial had fourteen living flies. So, reckoning from six days before the pain commenced for the laying of the eggs, to the twelfth day, when the maggot discharged, making eighteen days, and to this adding the twenty days during which the grubs were in the ground, we have thirty-eight days from the time the fly laid the eggs until a new generation of flies is produced from them.

You may think I have dwelt too long on these cases; but if

you had to stand at the bed and had seen the suffering and despair of the patients, and found that the worms were eating them up, you would not think so. All these cases occurred in the month of September.—*Fred. Humbert, M. D., F. C. S.*

[Upon this communication Dr. C. V. Riley says, that the insect here referred to as attacking a human subject in Illinois, "is the *Lucilia macellaria* of Fabricius, the injuries of which to different animals are well known in the South and West, where the larva is called the 'screw-worm.' I have repeatedly endeavored to obtain the true parent of this worm. Dr. Humbert's communication is most interesting, but the specimens yet more so, as the flies he forwards are the first that have positively been bred from the larvæ known as 'screw-worms,' and they confirm the above determination of the species. The larvæ agree with others which I have from Texas, taken from the root of the ear of a hog which had been bitten by a dog."]—*Proc. U. S. Nat. Mus., Sept., 1883, p. 103.* Compare also Professor F. S. Snow's article in *Psyche*, Mar., Ap., 1883, and S. W. Williston in *Psyche*, Nov., Dec., 1883. —Eds. Naturalist.

Entomological Notes.—G. W. and E. G. Peckham have published in the Proceedings of the Davenport Academy of Sciences detailed descriptions of twenty-five species of spiders of the family Attidæ, illustrated by three rather rude photo-lithographic plates. The authors, who live in Milwaukee, are engaged upon a monograph of this family, and desire specimens of the group from all parts of the continent; they have made a good beginning and should receive aid from all quarters.——An account of the transformations of *Aglossa pinguinalis* by the late W. Buckler, appears in the *Entomologists' Monthly Magazine*, for February. So far from living on fatty substances, as stated by Rolander, which led Linnaeus to give it its specific name, Buckler states that it lives in comparative darkness, in stables, barns, and out-houses, in masses of rubbish, hidden within a protecting sheath or galley nearly or quite close to the ground, composed of materials in which they find both their food and their covering; "unless disturbed, they are never to be seen whilst growing, as they do not voluntarily leave their abodes until full-fed; but then only do they desert their quarters, and may occasionally be observed ascending walls to find a suitable place for pupation."

ZOOLOGY.

Atavism Considered as a Conservative Agent in a State of Nature.—Atavism, although a very important factor in the preservation of species, receives but little of the recognition it deserves as such; because its action in nature is not superficially apparent enough to command attention and observation, and so, though ancient in name as well as existence it may still, as far as practicable observation goes, and to all intents and purposes

be considered in its major and readily recognizable manifestations as a resultant of artificial selection, being a concomitant upon the notable unstability of forms so produced; as it rarely, if ever, occurs in appreciable degrees in organisms which have been uninfluenced by man's fostering care.

Because nature changes and develops her products so slowly that when a modification does take place, the adaptation called for, owing to the all-powerful unyielding inorganic evolution, which may be regarded as the primal cause in the production and continuance of organic evolution, is nearly always different from any of the requirements that preceded it; and the tendency is rather to gradually depart still further from the ancestral branch than to revert back towards it.

By domestication, while we, as it were, magnify the natural tendency towards variability, we also at the same time, through organic correlation, increase its coördinate force, atavism, and by this means make it apparent to the most superficial observation, and thus enable us, as has been done in the case of artificially exaggerated variability, to reason by analogy of its existence under natural conditions and of its function and mode of action there.

For while it is probably one of the most frequent and powerfully operative forces brought to bear upon organisms in a state of nature, it is confined within comparatively narrow limits, and depends rather upon continuous action, as with its collaborators, direct heredity and variability, each separate coëfficient, of which there may be several acting synchronously in the same individual, unites in producing evenly blending results with its fellows, and is bounded by the first fixed varietal characteristics existing in the immediate ancestral line.

In domesticated varieties the nearest strongly fixed point, notwithstanding the number of changes they may have undergone, or the length of time they have existed as such, is generally the ancestral feral stock, which had become stable by reason of the prepotency of natural selection.

This is especially manifest in the case of color for reasons to be noted further on. In nature its manifestations are so slight as to escape the most critical observations, necessarily, from want of proper conditions for study without trammeling and thereby modifying to a greater or less extent the species brought under observation. The characters produced by artificial selection, as exhibited in domesticated organisms, become stable only in a secondary degree and by lesser causes, namely, on account of their usefulness to man, and are preserved only through his continued supervision. That they would be, and are, as a rule, detrimental to the organisms if left to themselves, is, of course, self-evident. Consequently, they can never become so potent as characteristics derived through the agency of natural selection,

and fixed by the primary cause of prepotency, usefulness to the individuals themselves.

The function of atavism is in all probability that of serving as a restraining influence against what might otherwise be a too rapid divergence in any one direction, before surrounding and semi-dependent parts, and special instincts have become modified in such a manner as to functionate harmoniously with it. To illustrate; a too sudden change of color presenting itself, and becoming inherited in a species of bird, dependent upon it to a certain extent for protection, would, if occurring before its mental attributes had sufficient time to evolve with, and adapt themselves to it, tend towards the extinction of the individuals manifesting it, from a failure of the instinctive actions to properly perform their offices in producing the protective effects intended, while the individual cases of atavism of color, with unchanged instincts, would escape. So by the continual preservation of individuals occurring in any untoward varietal forms, atavism became a fixed law, acting as a governor to the organisms over which it holds sway, and so equalizing and neutralizing the forces and inherent tendencies towards individual and consequent specific variability, as to best serve their interests. Though in it we may also find the explanation of the extinction of some of the great races of the past, in whom, on account of the want of proper incentives to struggle for existence, they remained stationary long enough to allow it to become thoroughly fixed, and thus become so prepotent over the natural adaptive inclinations of variability by the action of selection to assume the new and necessary modifications demanded by changes of environment, as to counteract all such tendency, and, by so overreaching itself, in fact, become suicidal in its nature.

The primal cause of atavism, and the reason for such an inheritance, is found in the knowledge that all animals preserve and pass through the same embryonic stages as their immediate ancestors, as well as retaining landmarks of the more prominent changes through which they in their evolution have passed. In nearly related species the individuals do not differ perceptibly until near the latter part of the embryotic period, and in many not until after it has been passed.

Individuals at times come in contact with disturbing, physical or nervous influences, by which some change in the system, that arrests embryological developments to a greater or less degree in one or more parts, takes effect at the time when those certain stages of varietal divergence are being developed.

An arresting of divergence does not necessitate the loss of power to develop to maturity, but will often produce what might be termed premature development. Therefore the varietal evolution being arrested by certain disturbing influences, certain varietal germs are aborted, and the product is a preparental form or rever-

sion to one or more varietal ancestral characteristics. Under domestication color is more subject to change than any other feature. The principal reasons for this being, first, that it does not require for its production a correlative diversification of adjacent features. Any organic change of form necessarily causes some modification of the surrounding tissues and adjoining parts, thus requiring more time, energy, and force than a mere slight change of the color-secreting tissue. Second, as it is comparatively so easily affected, it has been subject to more of the passing whims and fancies of mankind than any other part, especially as it does not require the patience necessary to produce a change of form or feature.

Therefore, from already being one of the most unstable characters, man has rendered it still more so by the comparatively rapid changes that it has been compelled to undergo under the dictation of his selective inclination. Being so susceptible to variation from the parental marking and coloring, it is also the part in which we should expect atavism to occur most frequently, as is the fact.

As a theoretical illustration we will represent the development of a domesticated bird, from the beginning of life in the egg to the adult, by *A* to *Y a*, which will represent the young, and *Z a* the adult, *a* representing coloration. And a variety produced by artificial selection from the parent stock by *Z 1 b* (*1* form, *b* color). *Z 1 b* will, of course, have to pass through the same embryological stages as *Z a*, because it was derived from that stock.

As we regard the different variations of form of the species through which a variety passed before reaching its present characteristics, as remaining though usually dormant, by reason of developing or changing into the next, before the final mature form is reached, and having its representative in some embryonic or juvenile period of growth; so, if we conceive the further development as a whole or in part, checked or aborted, at a period when it is rising to the peculiarities of the next or adult form, we can perceive that those special germs whose further development is arrested will simply mature with the prior features without further evolution.

Returning to our illustration again, with *Z 1 b*, we will suppose that by some abnormal condition an arresting of that feature most susceptible to change, color is brought about. Coloration may probably commence development at *R 1*, or some other unknown period, and reach the original preparental characteristic coloration at *V*, and change to the special varietal characteristics at *X*; now, if *W* is aborted, *V* may continue to mature while the tendency is still towards the previous parent stock, and before the peculiarities of their immediate parentage have had an opportunity to dominate.

As various parts commence to develop at different times, a check

upon development at one period might only retard such features as were then commencing to develop; and those which were already too far advanced, and such as had practically no existence, would not be effected. Thus the other unaffected features would continue to develop until maturity towards those of the parents, while the feature which had been aborted would remain stationary, only maturing with the preparental feature, by correlation, at the proper time, and the result would be the form of *Z 1* + the colors *a* = *Z 1 a*.—*Eugene N. S. Ringueberg.*

A Transparent Cave Sponge.—How great, says Dr. W. Marshall, in the *Annals and Magazine of Natural History* for December, 1883, is the power of adaptation in the fresh-water sponges, is strikingly proved by the interesting discovery of Dr. Joseph, who found in the grotto of Gurk in Carniolia an absolutely *transparent* (!) form of Spongilla (*Sp. stygia*). As I supposed that this fresh-water sponge, which lives all the year round under the same, or nearly the same, conditions of existence, would form no gemmules, as these would be superfluous, I applied by letter to Dr. Joseph, who forwarded some preparations to me, and at the same time kindly wrote, among other things, as follows: "Your supposition that no formation of gemmules takes place is correct, for neither in September nor in April did I find any." Some people may perhaps think that the Spongillæ of the grotto of Gurk were not descended from ordinary Spongillæ, but directly from Monaclinellidæ of salt water, perhaps at a time when the waves of the Tertiary sea eroded the grottoes of Carniolia and Friuli. This would have much more probability than the supposition that in consequence of uniform conditions of existence, not dependent upon the seasons, retrogression as regards the gemmules has occurred in *Spongilla stygia*.

New Worm with a remarkable Nervous System.—The *Willem Barents*, on her third voyage, captured a worm which A. A. W. Hubrecht describes under the name of *Pseudonemertes nervosum*. He gives a general account of its structure, and promises a fuller monograph. The animal is about sixty-five mm. long, one and three-quarters mm. thick, tapering behind. The digestive tract runs straight through, from end to end. On the ventral side, about forty-five mm. from the head, is a disk, probably a sucker. No traces of sexual, excretory, or sensory organs were found. The epidermis is thin. The muscles form three layers, a thick external longitudinal, a middle transverse or circular, and an internal longitudinal layer, variously developed in different parts of the body. The nervous system is very remarkable; it forms a continuous layer completely around the body, and lies immediately inside the layer of circular muscular fibers. It consists (1) of a fine network of delicate filaments, appearing as if felted, barely tinged by the staining reagents; and (2) of scat-

tered nuclei, belonging partly to connective tissue, partly to ganglion cells. The layer forms a continuous tube from the head, where there is no ganglionic enlargement, back through the body to the caudal region, where the layer is present dorsally only.

New and Remarkable Pentastomum in the Air-sacs of a Gull.—P. Mégnin describes a new and remarkable Pentastomum found in the air-sacs of *Larus glaucus*. About six centimeters long and one broad, it has at first sight the appearance of a Trematode; but a microscopic examination reveals the presence of two pairs of symmetrically placed hooks at the anterior end. The new species is remarkable for the attenuated form of the anterior extremity, and the absence of any external annulation. At the front end there are two tubercles which look like aborted antennæ, and below there is an indication of a kind of segment.

On what may be regarded as the second ring there is a pair of small appendages, formed of two joints, which call to mind the characters of larval Pentastomes. The characters of these new species resemble greatly those of the Lernæidæ, and especially of the Chondracanthidæ, and seem to M. Mégnin to raise the question of the systematic affinities of these parasites. If the resemblance to the Lernæidæ is a real one, the Pentastomidæ should be ranged rather with the Crustacea than with the Arachnida.

The Side Organs of Gastrostomus.—Mr. J. A. Ryder communicates to *Science* a description and sketches of the curious pedunculated organs of the lateral line of Gastrostomus. These are placed in groups of from two to five, forming an oblique row on the hinder margin of each muscular somite. The stalks are slender, fully a sixteenth of an inch long, and project outwards quite freely when the fish is immersed in alcohol or water. At the tip of each is a discoidal, more or less cup-shaped organ, which is more or less completely pigmented internally. The peduncles are not pigmented, and the pigment upon the circular areas immediately around the base of each peduncle is slightly reticular and less dense than that of the surrounding skin, which is deeply loaded with black. The pigmented layer of the basal disks is continuous with the outer clear sheaths of the stalks, and the medullary portion of the stalk can be seen in some cases to consist mainly of nerve-fibrils, which pass outwards to the cup-like organs at the tip. Mr. Ryder believes these organs to be tactile, and possibly luminous. In some young fishes there are naked nerve-hills on the sides of the body, and in the young of Gadus the stiff, sensory hairs of these nerve-hills project into the surrounding water; but no larval fish as yet known has pedunculated side-organs, so that in this respect, as in the rest of its organization, Gastrostomus is highly specialized.

ZOOLOGICAL NOTES.—*Protozoans.*—Professor Haeckel, in a recent paper (Sitz. Jenaischen Gesell. für Med. und Wiss., 1883) divides the Radiolaria into four orders: Acantharia, Spumellaria, Nassellaria and Phæodaria. The first are distinguished by their organic acanthine skeleton, and never have a true silicious skeleton. On the whole, they correspond to the Acanthometræ of J. Müller, but include part of the Haliomma. Actinelius, in which the central capsule is pierced by numerous simple, indefinitely arranged spicules meeting in its center, seems to be the ancestral form, and to have arisen immediately from Actinosphærium by the hardening of the firmer axial fibers into spicules. The Spumellaria have no acanthine skeleton, but their central capsule is pierced on all sides by fine pores. The ancestral form is Actissa, the simplest possible Radiolarian. The Nassellaria have a simple area of pores at one end of the capsule axis. The skeletonless *Cystidium inerme* is regarded as an ancestral form, from which others were derived by the development of a silicious skeleton. The Phæodaria surpass all other Radiolarians in size and singularity of form. The skeleton is usually composed of hollow silicious tubes. The common characteristic of the whole order is the *phæodium*, a dark body of pigment, lying excentrically outside the central capsule. The ancestral form is the skeletonless Phæodina.

Cœlenterates.—Dr. von Martens reports, from a letter of the African traveler, Dr. R. Böhm, that a jelly-fish has been discovered in Lake Tanganyika. It belongs to the Craspedote medusæ; has a small, short, broad stomach, while the tentacles are very numerous and of unequal length.

Polyzoans.—The memoirs of the Novorossian Society contain an elaborate paper by M. Repyakoff, on the relations between the Endoproct and Ectoproct Polyzoa. In the same memoirs, M. Buchinsky publishes a paper on the development of the earthworm, with special attention to its mesoderm and nervous system.

Mollusks.—At a recent meeting of the Academy of Sciences of Paris, M. de Lacaze-Duthiers presented a note by M. Houssaye upon the operculum of the Gasteropoda. This investigator has come to the conclusion, contrary to what is generally admitted, that the entire surface of the foot does not take part in the production of the operculum, which is secreted by a small and clearly limited portion of the epithelium. This mode of production seems to be of a different nature from that of the byssus of the Acephala which is formed by a well-developed gland, occupying a considerable part of the volume of the foot. The researches were carried on partly at the laboratory of Banyuls-sur-Mer, and partly at the laboratory of l'Ecole Normale, with animals sent from Roscoff.

Crustaceans.—The transformations of a Rhizocephalus and its mode of fixation are, according to M. Ives Delage, who has occupied

three years at Roscoff in observations and experiments upon the subject, more wonderful than has been hitherto believed. The nauplius, after four days and five months, transforms into a cypris, which refuses for three days to fix itself. Then, always during darkness, it attaches itself to young crabs from two to twelve millimeters in width, seizing a hair of the crab with its prehensile antennæ. It may become fixed to any part, but prefers the back of the tail or the base of the legs, never the ventral face of the abdomen. As soon as it is fixed, it is transformed by a molt into a sort of lengthened sac, suspended by its antennæ, and without limbs. This sac secretes at its antennal pole a hollow dart, ending below in a funnel opening into the cavity of the sac, and above in a very sharp point. This dart passes through the cavity of the antennæ that has seized the hair, and pierces the teguments of the crab at the soft ring at the base of the hair. The contents of the sac then commence to enter the funnel end of the hollow dart, and pass gradually into the tissues of the victim. The contents of the sac consist of cellules, of which the superficial ones represent the cellular skin of the larva, while the central ones are a sort of nucleus which existed in the nauplius and cypris, and constitutes the genital organs. When the Sacculina has thus inoculated itself into the body of the crab, it travels to the abdominal region, and the genital nucleus pierces its envelope and the teguments of its host, and appears upon the outside of the crab. Thus the portion of the parasite in the body represents the skin of the larva. The name of Rhizocephalus is therefore inexact, and M. Delage proposes for the group the name *Kentrogonides*, and considers them very different from either Lerneans or Cirrhipeds. The parasite does not fix itself to the zoëa, nor to crabs that have passed a certain age.——Among the Crustacea found by the French expedition to Cape Horn, the most common were the large spiny *Lithodes antarctica;* another, Lithodes *(L. verrucosa)*, with shorter limbs; a Eurypodius, with extraordinarily long limbs; a small Halicarcinus, with a flattened body; a Galatea, and more rarely some shrimps and isopods, among the latter of which the genus Serolis was most common.

Fishes.—M. Ralph S. Tarr, in a communication to *Science*, states that in the winter of 1878–79, a million and a half of cod were successfully hatched at Gloucester, Mass., and placed in the clearer waters of the outer harbor. Great numbers of young fish of this species have since been caught, both in the outer and inner harbor, and the results have proved so favorable that an appropriation was obtained from Congress to build the extensive hatching-houses and basins now in course of erection at Wood's Holl, Mass.——At a recent meeting of the Linnean Society of New South Wales, Mr. Ch. de Vis described the following new species of fishes from New Britain and the adjoining islands: *Serranus perguttatus* and *cruentus*, *Mesoprion flavirosea*, *Tetraroge*

vestita, *Acanthurus zebra*, *Rhynchichthys novæ-brittaniæ*, *Harpage rosea* (a new Berycoid genus), *Salarias æquipinnis*, *Amphiprion arion*, *Pomacentrus onyx* and *notatus*, *Nesiotes purpurescens* (a new Labroid genus), *Exocætus longibarba*, *Arius armiger*, *Herpetichthys cobra* (a new Murænoid genus), *Tetrodon insularium* and *lævis*. At the same meeting Mr. W. Macleay gave a list of the fishes captured by a beam trawl outside Port Jackson, in forty to fifty fathoms, and described the two new species, *Raia australis* and *Lepidotrigla mulhalli*.——At a recent meeting of the Linnean Society of New South Wales, Baron M. Mikluko Maclay and Wm Mackay contribute a paper on the Plagiostomata of the Pacific, and describe *Heterodontus japonicus*. The latter gentleman also describes *Psilecranium coxii*, a large fish of the family Cirrhitidæ, taken at Port Jackson. It is rather near to Chilodactylus.—— Dr. T. Gill, in a communication addressed to *Nature*, January 10, 1884, asks for further information respecting the Saccopharyngidæ, which he believes to be Lyomeri, with the branchio-anal portion much longer than the rostro-branchial, while the reverse obtains in Eurypharynx and Gastrostomus.

Reptiles.—M. W. Mackay has described *Tiaris boydii*, a lizard from the Herbert river, Queensland, and three snakes from the same locality: a Tropidonotus, a Dendrophus, and *Herbertepsis plumbeus*, a new genus near Coronella.

Mammals.—Baron Maclay finds the average temperature of the body of the Echidna to be 78° F., or very little more than that of fish.——M. H. Gervais has described a new species of Megaptera from the bay of Bassorah. Van Beneden, in a recent work, has referred the humpbacks to a single species, but M. Gervais combats this, and recognizes three, *M. boops*, of the northern hemisphere; *M. Lalandii*, inhabiting the South Atlantic; and the species from the Persian gulf, a species which he names *M. indica*. In size this form equals *M. boops*, but the head is more globular and the bones thicker, as well as more compact and denser. The upper profile of the head is more curved, the rostrum more obtuse, and the mandible more arched. The exoccipitals project more and the condyles less than in *M. boops;* the occipital foramen looks more backward; the zygomatic process is shorter and more massive; and the palatines differ from the northern species in their form, their greater thickness, and their extensive articulation with the maxillary. The sternum differs completely in its form from that of any other whalebone whale. There are also many other differences in the shape of the bones of the skull, vertebra, ribs, etc., and the pectorals are proportionately longer than in *M. boops*.

PSYCHOLOGY.

PETER'S SEARCH FOR HOME—ANOTHER CAT STORY.—"Peter" is the name of a small-sized cat now lying at my feet under the kitchen stove, reposing in what might be called a condition of

"solid comfort." He is a most sagacious, affectionate little fellow some seven or eight years old. One of his "specialties" is conversation. Ask him a question, or say, "Good morning, Peter!" and his invariable response is—"Mew!" Ask him a dozen questions in succession, and he seldom fails to answer. I tell him, sometimes, to "whisper," and then he speaks very low, often merely opening his mouth. We think that Peter knows almost everything that cats are ever privileged to know. But here is his little story.

A year ago last August he was taken to town, two miles away, to live with another family. The road lies across a bend in Boone river, the crossing at the upper place being by a bridge, and at the lower one by a ford. Forty rods below the ford, however, there is a long and high railroad bridge. To go around this bend one would have to travel nearly or quite six miles. Well, Peter was kept in close confinement at his new home for a whole week, but upon being released he left, as the Arkansas swamp doctor says, *ad instanti!* Nothing was heard of him for over two months, and we all supposed that dear little "Peter"

> "By the wayside fell and perished,
> Wearied with the march of life!"

Late one November evening, however, his mistress heard and recognized his "voice" out in the garden. But he had been so long without a home, following such devious, hidden ways, that the caution of feral life had well nigh come back to him, and he seemed half afraid to come directly into the house. But a little persuasion finally overcame whatever doubts were flitting through his little brain, and he allowed himself to be caught. Upon getting into the house he was the most pleased, overjoyed animal I ever saw. He talked, and talked, and talked, and "answered questions" until at last his vocal organs utterly gave out, failing to utter any sound whatever, and he could only open his mouth in the vain attempt. In fact, "he was so hoarse that he couldn't speak" for the next two or three days. It was many days before he could give up celebrating his return by his manifestations of delight and pleasure, and settle down to his normal condition of demure, cat life.

On his return he was in good physical condition, but without a particle of fat. His muscles were plump and round, like those of a trained athlete, and it was evident that on his long march for home he had lived upon such meat as he could catch—birds, mice, rabbits, squirrels, &c. But the question was, How did he reach home? By the bridges, or did he come around the bend? He could not know the way home, for he was carried off in a box, and must have been all this time wandering here and there. By sheer good luck he finally achieved the object of his long quest only a few hours before the first winter "blizzard" came howling over the prairies. If his talk were only a little more in-

telligible, I believe that his account of his wanderings, his adventures, his hopes and fears, the big dogs and other dangers from which he must have had narrow escapes, would form one of the most interesting chapters in natural history.

One other fact concerning "Peter" also seems a little out of the way. I often take him on my shoulder for a horseback ride, and he seems to enjoy that sort of diversion very much, and is never afraid, while few other cats could be made to stay a single moment.—*Charles Aldrich, Webster City, Iowa, March 9, 1884.*

THE TEN COMMANDMENTS.—1. If thou art not born an original investigator, thou hadst better teach or compile the works of thy brethren the original investigators.

2. Thou shalt not say, lo! give me money and I will originally investigate; for thy people knoweth that if thou canst not originally investigate without money, thou canst not do it with money.

3. If thou desirest to increase thy reputation by depreciating the reputation of thy brethren, know that this is not the object of original investigation.

4. Thou shalt not pretend to discover the general laws of the earth and the things thereof until thou knowest the thing thereof, even the species.

5. Thou shalt therefore not despise him who furnisheth thee with the materials of thy thoughts, even him who describeth species well.

6. Thou shalt not believe that the bigness of the man of science is proportioned to the smallness of the hole through which he seëth the world and the things thereof.

7. Thou shalt not believe that the bigness of the man of science is in proportion to the size and beauty of the pictures which he maketh.

8. Thou shalt not fall into the snare of the Devil, and believe that thou wilt wax great by the making of great names to torment thy people.

9. Thou shalt not write obituaries until thou art well stricken in years.

10. Thou shalt not take the name of the National Academy of Sciences in vain, for thy people knoweth that inwardly thou desirest to be a member thereof.

POETRY IN DREAMS.—In a recent NATURALIST, I saw some "poetry" said to have run through the minds of individuals in dreams, and to have been afterwards recalled. That "reminds me" of an incident in my own experience. I once dreamed of writing several "verses," one of which I have always remembered —or did I get hold of it by some other and forgotten means? I

believe I "dreamed it," and here it is. The four or five other verses I am unable now to recall:

"The past has been a fleeting shadow,
Like mist on the mountain side,
But through the future before me
Glowing visions swiftly glide!"

Unless I came across this in some book or newspaper, I shall always believe that I composed it in my dream. Next!—*A., 1884.*

ANTHROPOLOGY.[1]

THE NORTHERN FRONTIER OF CHINA.—When the Mongols first becam epowerful under Chinghis Khan, Eastern and Central Asia was divided into four considerable empires: 1. The Kin or Golden Tartars occupied the six northern provinces of China, they were the ancestors of the Manchus; 2. Central Asia was subject to the empire of the Kara Khitai; 3. The Sung dynasty, controlling Southern China, was a purely Chinese empire; 4. The fourth empire was that known to the Chinese as Hia or Tangut, and forms the subject of Part VI in a series of papers on the northern frontages of China, by H. H. Howorth, published in the Journal of the Royal Asiatic Society.

THE PEOPLING OF THE EARTH.—M. Zabarowski, a distinguished member of the Paris faculty of anthropology, reviews the various theories of the distribution of our race over the earth. The peopling of the earth is at present regarded from two points of view. The first is the belief that man has not appeared simultaneously in all the grand divisions. On the contrary, in the savage state, deprived of the facilities at our disposal, men have effected migrations on a grand scale. Upon this point M. de Quatrefages has successfully opposed the theories of Agassiz, that there were as many centers of human origin as there are races of men.

THE TRIBES OF EGYPTIAN SUDAN.—Professor A. H. Keane contributes to *Nature* of Jan. 24, a paper on the Egyptian Sudan and its inhabitants, an abstract of which is given below. Sudan is the Arabic equivalent of Nigritia, Negroland. Its sections are: (1) *Western Sudan*, the basins of the Senegal and Quovra-Bénue (Niger); (2) *Central Sudan*, the basins of the Komadugu and Shau, with lands draining into Lake Chad; (3) Eastern Sudan, east of Waidai, the Upper and Middle Nile basin, now known as *Egyptian Sudan*. The provinces formed out of this territory in 1882 were:

WEST SUDAN—Darfur, Kordofan, Bahrel-Ghazal and Dongola, with capital, Fasher.
CENTRAL SUDAN—Khartum, Senaar, Berber, Fashoda and the Equator (Hat-el-Istwa), capital Khartum.
EAST SUDAN—Taka, Suakin and Massowah, with capital, Massowah.
HARRAR—Zeyla, Berbera and Harrar, with capital, Harrar.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

The following is Mr. Keane's ethnologic chart.

RACE	MAIN DIVISIONS.	LOCALITY.	REMARKS.
HAMITES.	*Tibbu:* Baele, Zoghawa, Wanyanga.	N. & N. W. Darfur.	*Hamite, Kushite* of some writers, answering to the African division of the Mediterranean or Caucasic anthropologic type. For the removal of Tibbu from the Negro to the Hamite race, see *Nature*, March 1, 1883 (North African Ethnology). Most of these are zealous Muhammadans.
	Bishari (Beja): Hadendoa, Hallenga, Ababdeh, Beni-Amer.	Between Red sea and Nile, 15°–25° N.	
	Danakil: Adaiel, Dahimela, etc.	Between Abyssinian coast, 10°–15° N.	
	Saho; Bogos; Habab;	Massowah district.	
	Somali: Idur; Isa; Mijarten, etc.	Gulf of Aden coast.	
	Galla (Orma): Yeju, Wolls, Mecha, etc.	E. and S. of Gojam.	
SEMITE.	*Arab:*		The Arab Semites are recent intruders, mainly *via* Isthmus of Suez and Egypt. The Himyarites are intruders from prehistoric times, from S. Arabia *via* Strait of Bab-el Mandeb. The former Muhammadans, the latter monophysite Christians.
	Kabahish; Sheygieh; Robabat, etc.	W. f. Nile, bet. Dongola & Khartum.	
	Homran; Rekhabin; Alawin.	Senaar.	
	Homran; Hanor; El-Hanor; Habanich, etc.	Kordofan and Darfur.	
	Ziaieh; Bahemid.	N. Darfur.	
	Himyaritic:		
	Tigré; Dembela; Lasta;	N. and E. Abyssinia.	
	Harrari.	E. from Shoa.	
NUBA.	*Barabra* (mixed)- Kenus, Mahasi; Dongolawi.	Nile valley, Egypt to Old Dongola.	*Nubas* intermediate between the Negro and the Hamite. Speech, Negro. No connection with the Fulah of W. Sudan. The Kordofan Nubas original stock, Pagans. Those of the Nile, Negroid Christians from v–xiv cent. Since then mild Muhammadans. They are the Uaua of Egyptian records; *Nubæ* of Strabo, later Nubatæ.
	True Nuba: Kargo; Kultan; Kolaji; Jebel Nuba, Tumali.	Kordofan.	
	Fur: Fur; Konjara; Fongoro, etc.	Darfur.	
	Sub-Nuba: Takruri,	Gallibat.	
	Barea; Basé (Kunama);	Taka, Mareb valley.	
	Funj; Hamagh.	Senaar.	
NEGRO.	*Sudanese:* Beikit; Masalit, Abu-sarib, etc.	Darfur.	Most of these Negroes still Pagans. Some, as Mittu, Krej and Bongo, red-brown rather than black, but the type is Negro. Speech of all except the Dinka, shows grammatic gender.
	Nilotic: Shilluk, Dinka, Nuer.	White Nile and B. el Arab.	
	Fallaugh; Kumbung; Ninak, etc.	Sobat basin.	
	Krej; Bongo (Dor); Mittu (Moro).	About W. tributaries of White Nile.	
	Bari; Madi; Lur; Latuka.	B. el Jebel, N. of L. Albert Nyanza.	
BANTU.	Waganda; Wanyoro, Wasoga; Wagamba.	Extreme S. frontier, N. side of L. Victoria Nyanza.	Bantus not reduced. Included in the Moudirie de l'Equateur of Messedaglia, official, "Carte du Sudan" (Khartum, 1883).

THE COLOR OF THE EYES AND HAIR.—M. C. Ikow contributes to the Bulletin of the Paris Society of Anthropology, Vol. XVI, pp.

440–457, a paper on the classification of the color of the eyes and of the hair. Our knowledge of the nature of pigment in man and the other mammals is unfortunately still imperfect; we do not know whether the coloring matter is unique or whether there are many elements by whose combination the great variety of color is produced. M. Ikow, therefore, claims only to have made use of facts so far as they have been established. The following is his scheme:

PRIMARY GROUP.

1. *First fundamental natural group.*— The iris contains no pigment.	The iris is blue or gray of diverse shades, according to the nature of the iris.	Apparent color of the iris, blue or gray, of different intensity (tone).
2. Second fundamental natural group.— The iris contains pigment which occupies the entire field.	The iris is in reality brown, varying from yellow-brown to black-brown.	The apparent does not differ from the real color, although it seems of a little deeper intensity.

SECONDARY GROUP.

3. Intermediate group between the two fundamentals.—The pigment is deposited in the iris but does not occupy more than a third or two of its field. A peripheral zone is completely deprived of pigment.	The iris is composed of two parts: 1. A central zone around the pupil, brown or yellow in color according to the quantity of pigment; and 2. A peripheral zone of blue or gray color.	Color of the iris apparently sometimes green, sometimes yellow, sometimes bronze, rarely gray-yellow.

FUNDAMENTAL GROUPS.

Color of the Hair.

1. Blond hair (color of flax).	Pigment in small quantities.
2. Black hair (pure black and shining).	Pigment in considerable quantity.
3. Intermediate, chestnut brown.	Pigment in moderate quantity.
a. Clear chestnut. *b*. shaded chestnut.	

STONE IMPLEMENTS FROM MINNESOTA.—In 1881 Miss Frances E. Babbitt, of Little Falls, Minnesota, made the important discovery of stone implements and chips of quartz at the depth of fifteen feet in the gravel forming the modified drift on the banks of the Mississippi river at Little Falls, Morrow Co., Minn. Since then she has made repeated examinations of the gravel, and has taken out many specimens of chipped and worked quartz from the same stratum, all of which were found in a very limited area. A series of the specimens was exhibited at the Minneapolis meeting of the A. A. A. S., in connection with her paper, giving a full account of her work, and containing a statement on the geological conditions by Mr. Warren Upham, as assistant to the State geologist. In this account Mr. Upham gives his testimony to the discovery of the implements by Miss Babbitt, in the modified drift, and we therefore owe to her the knowledge of the existence of man at that early period in the Mississippi valley; another of the facts which are slowly but surely pointing to the great antiquity of man on our continent. After the meeting Miss Babbitt

most kindly presented the whole collection on exhibition to the Museum of Archæology at Cambridge, Mass., and since its arrival I have again examined the specimens, and have no hesitation in pronouncing a large proportion of them as the work of man. Some are simple chips or flakes, split off in the process of working the stones into shape. Others are pointed pieces of quartz which may in part be natural fractures, but which have received a few finishing blows from the hands of palæolithic men. A few others, including one or two not of quartz, are evidently natural forms, but in the collection are about a dozen unquestionably chipped implements, which, except that they are made of quartz instead of argillite, closely resemble the palæolithic implements found by Dr. Abbott in the New Jersey gravels. For the present I refer to Miss Babbitt's paper, now in course of publication by the American Association for the Advancement of Science for further details, but I hope at no very distant day to give illustrations of these specimens in our reports, as the museum has now become their owner.—*F. W. Putnam.*

MICROSCOPY AND HISTOLOGY.[1]

METHODS OF STUDYING THE SO-CALLED LIVER OF THE CRUSTACEA.[2]—For the study of fresh tissues Dr. Frenzel places a small piece of the organ on the slide, *in the blood of the individual from which it was taken;* or, *in sea-water diluted until the salt contained amounts to about* 1 ½–2 per cent (one part distilled water and one part sea-water from the Bay of Naples). The so-called "physiological salt solution" (¾ per cent) worked unfavorably, causing maceration.

Various fluids were employed for killing and hardening, partly for determining the effect of different reagents on the nuclei and the protoplasm, and partly for finding the best means of preparing the object for sectioning.

Very good preparations were obtained with *warm* alcohol from seventy per cent to ninety per cent; while direct immersion in absolute alcohol did not prove advantageous. This treatment gave good results for the cell protoplasm, but destroyed the structure of the nuclei. Still better results were obtained for the cells (not for the nuclei) by adding a few drops of iodine to seventy per cent alcohol.

The most satisfactory results were reached by immersing the object in a saturated aqueous solution of corrosive sublimate from ten to thirty minutes, then washing with water, and finally replacing the water gradually with alcohol.

Perenyi's fluid gave best results when combined with corrosive sublimate. The object was left from five to ten minutes in the

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] Johannes Frenzel. "Ueber die Mitteldarmdrüse der Crustaceen," Mittheil. a. d. Zool. Station, V, p. 51, 1884.

first-named fluid, then transferred to the second and left for the same time.

While these methods were good for the Decapods, Amphipods and Phronomidæ, the Isopods required a different treatment. With these Kleinenberg's picro-sulphuric acid, diluted with an equal volume of water, and allowed to act 15–20 minutes, gave much better preparations than the sublimate solution.

A NEW SECTION FLATTENER.—The following device as an anti-roller has been recommended by Gage and Smith:[1]

"The section flattener consists of a rod (*b*) of spring brass, about 5^{mm} in diameter, flattened on two sides (*B* and *D*), extending parallel with the edge of the knife, and projecting about 2^{mm} beyond it. Opposite the cutting edge the space between the rod and knife is about 1^{mm,} while nearer the back of the knife the distance is greater (Fig. 1 *D*, *a*, *b*). At each end the rod is bent at right angles. Next the handle it passes through a hollow cylinder (Fig. 1, *d*), into which it is secured by a milled nut (Fig. 1, *c*). At the free end of the knife, the rod is hooked over the back of the blade (Fig. 1, *A*), the spring of the wire securing it firmly. At the two angles of the rod it rests on the blade, so that in cutting sections any amount of pressure may be applied at these points. The rod is attached to the knife by means of a clamp, which consists of two pieces clasping the tang and held together by a screw (Fig. 1, *C*). To clean the knife and rod, or to remove sections, the rod may be raised as it swings freely in the hollow cylinder attached to (*d*). The rod may be removed by removing the milled nut (*c*); the entire apparatus may be removed from the knife by loosening the screw *(f)*."

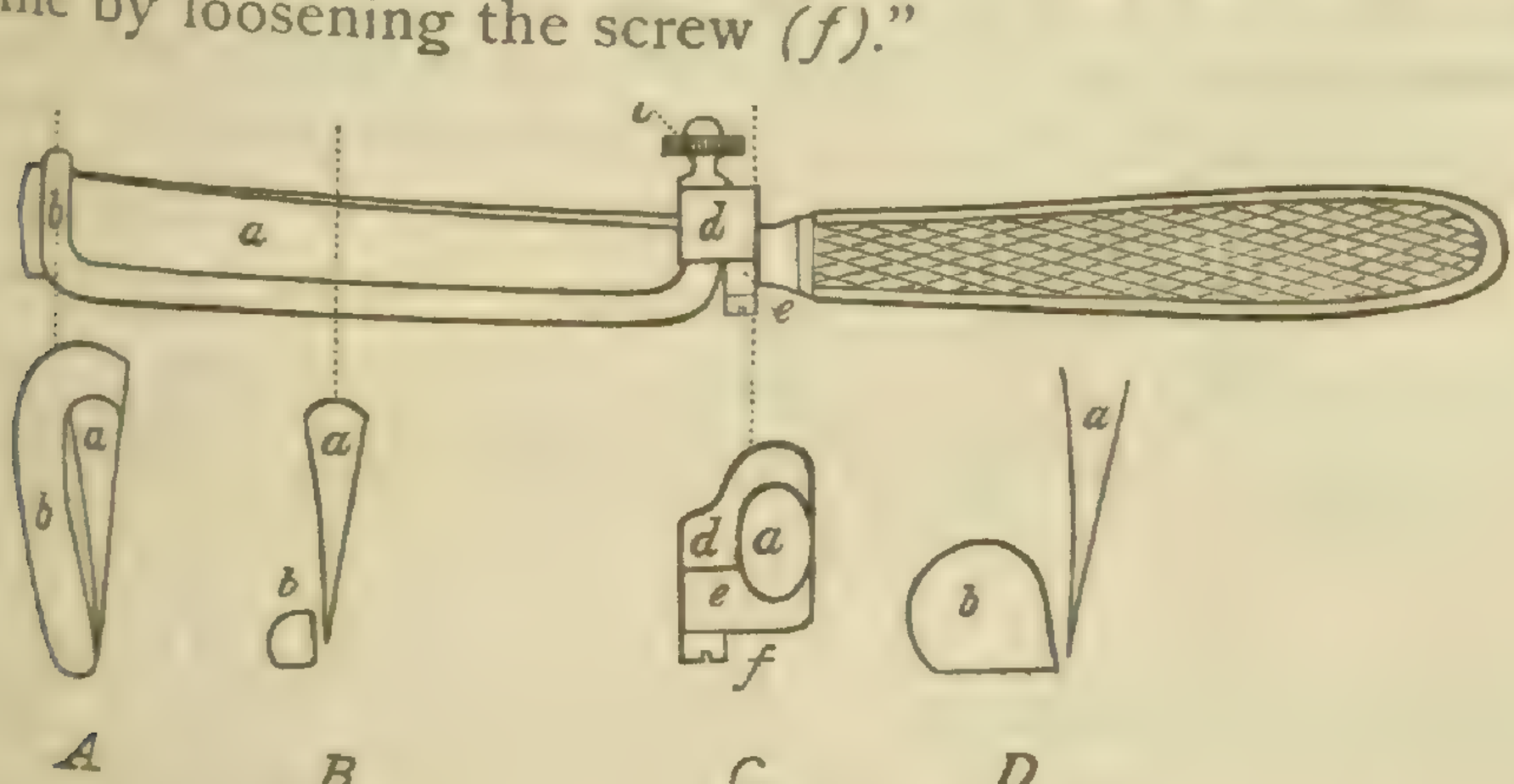


FIG. 1.—The section flattener attached to a knife. (*a*), blade of knife; (a^1), tang; (*b*), section flattener; (*c*), milled nut; (*d*), the part of the clamp bearing the hollow cylinder; (*e*), part of clamp; (*f*), screw holding the two parts of the clamp together.

A, section showing the end of the flattener hooked over the blade; *B* and *D*, sections showing the form of the rod (*b*), and its position with relation to the edge of the knife; *C*, section of the tang, showing the manner of attaching the clamp.

The section-smoother introduced by Andres, Giesbrecht, and

[1] "Section Flattener for Dry Section Cutting." *The Microscope, February, 1884.*

Mayer, described in the December number of this journal, is one of the simplest devices that has thus far been offered, and is perfectly adapted to both large and small sections. It is provided with an adjusting apparatus, the absence of which is a defect in the above instrument of Gage and Smith, and is applicable to knives of different forms and sizes.

Methods of Preparing the Alcyonaria.—Dr. Wilson[1] has employed with success the following methods in preparing the Alcyonaria for histological purposes:

"After testing many preservative and staining fluids, the following methods were adopted as giving, upon the whole, the best results: The animals were suddenly killed by momentary immersion in a mixture of one part strong acetic acid and two parts of a concentrated solution of corrosive sublimate in fresh water. After being quickly washed, they were transferred to a concentrated solution of sublimate in fresh water, and left two or three hours, the internal cavities being injected with the solution where this was possible. They were then thoroughly washed in running sea water, then in distilled water, and finally preserved in successive grades of alcohol.

"A weak solution of iodine in alcohol and sea water also gives beautiful results, but is less certain in its action. For staining I have used Grenacher's alum-carmine, borax-carmine, picro-carmine and Kleinenberg's hæmatoxyline. Much the best results are obtained by the use of alum-carmine, but it must be used as quickly as possible, since the gelatinous tissue of the mesoderm is apt to shrink if the object be left too long in aqueous fluids. The tissues were decalcified with very weak nitric or hydrochloric acid in ninety per cent alcohol. For maceration, the Hertwig's well-known mixture of osmic and acetic acids gives good results."

PERENYI'S FLUID.[2]—The following mixture is recommended by Perenyi for hardening eggs and embryos. It kills instantaneously, and preserves the object in its natural form and size without the least shrinkage. Eggs thus preserved are not brittle, but "cut like cartilage:"

Nitric acid (10 per cent)	4 parts.
90 per cent alcohol	3 "
Chromic acid (½ per cent)	3 "

This mixture assumes a violet hue after a short time.

Eggs may be left in this fluid 4–5 hours; then twenty-four hours in seventy per cent alcohol; then in ninety per cent. alcohol one or two days; finally 4–5 days in absolute alcohol.

The staining fluid may be best added to the fluid itself, so that the eggs are hardened and colored at the same time. Fuchsine

[1] Dr. E. B. Wilson, "The mesenterial Filaments of the Alcyonaria," Mittheilungen aus der Zoölog. Station zu Neapel. v., p. 3, 1884.

[2] Josef Perenyi. "Ueber eine neue Erhärtungsflüssigkeit," Zool. Anzeiger. v. No 119, p. 459, 1882.

and analine red dissolve directly in the fluid, while eosine and purpurine are first dissolved in three parts alcohol.

Picro-carmine or borax-carmine mixed with the fluid, give excellent staining. The addition of staining fluids causes a precipitate, so that before using the fluid should be filtered.

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SCIENTIFIC NEWS.

— In the death of Professor Arnold Guyot, who was born near Neufchatel, in 1807, we have lost our most eminent geographer, and a geologist whose reputation was worldwide. He began his life's work as a student of Ritter, the influence of whose instruction is seen in the "Earth and Man." While a professor in the University of Neufchatel, where he filled the chair of universal history and physical geography, from 1839 to 1848, he studied, with Agassiz, the structure and physics of the existing glaciers, but especially distinguished himself by determining the limits of the ancient glaciers of Switzerland, Savoy and Lombardy, and demonstrated the identity of the laws of the distribution of erratic boulders and gravels with those of glacial moraines. In 1848 he came to this country, and was for thirty years perhaps the most distinguished member of the faculty of Princeton College. While here he organized for the Smithsonian Institution a system of meteorological observations, and thus paved the way for the establishment of the present signal bureau. His most important geographical essay was his "Physical structure of the Appalachian mountains" (1861). He wrote a series of text-books on physical geography, and stimulated greatly the popular interest and appreciation of this subject. As a lecturer and writer, he was clear, comprehensive and finished; as a man, singularly pure, simple-hearted, unselfish and sincere. It was a benediction to come in contact with him.

— Dr. George Engelmann, who died February 4, was born at Frankfort-on-the-Main, February 2, 1809. Removing to the United States in 1832, he soon after settled as a physician at St. Louis. His botanical studies, which made him famous, were carried on in the limited leisure of a busy practice. For nearly thirty years he studied the Cactaceæ, his elaborate monographs appearing in the reports of the Pacific Railroad and the Texas Boundary survey. He monographed the pines, and the North American group of Cuscuta, Juncus, Euphorbia, Quercus, Vitis and Agave. He ranked as a botanist only second to Dr. Gray. He was one of the founders and most active members of the St. Louis Academy of Science. He also was the oldest American meteorologist, his observations extending over a period of forty years.

— The *Zoölogischer Jahresbericht for 1882*, so far as relates to the invertebrates, has made its appearance. It is of the same size, with the same editors, as in former years, and is equally in-

valuable to the American zoölogist on account of its detailed summaries of papers and works devoted to zoölogy in all its relations. The different divisions are for sale separately. No biological laboratory, college, or museum library is complete without this work, as well as the briefer English *Zoölogical Record.* It is earnestly to be hoped that, though the German *Jahresbericht* is published at great expense of time and money, it will not be suspended for want of adequate support. American zoölogists will find the work peculiarly valuable.

— At the meeting of the Geological Society of London, held February 15, the society's Lyell medal was awarded to Dr. Joseph Leidy, of Philadelphia, with the sum of 25*l.*, in recognition of his valuable services to palæontology, especially his investigations on the fossil Mammalia of Nebraska and the Sauria of the United States. The council also awarded to Professor Leo Lesquereux, F. C. G. S., the sum of 20*l.* from the proceeds of the Barlow-Jameson fund, in recognition of the value of his researches into the palæobotany of North America, and to aid him in further investigations of a similar kind.

— Drs. D. G. Brinton and Benjamin Sharp have been elected to the chairs of Archæology and Ethnology and Invertebrate Zoölogy respectively, in the Philadelphia Academy of Natural Sciences.

— The University of Pennsylvania is about to establish a school of biological research, and has raised a fund for its endowment.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, March 8.—Communications: Dr. J. H. Kidder, U. S. N., Exhibition of specimens of bacillus tuberculosis; Dr. D. E. Salmon, Exhibition of specimens of infectious tuberculosis in cattle; Col. Marshall McDonald, The influence of temperature upon the movements of fish in rivers; Mr. Charles W. Smiley, What fish-culture has first to accomplish. Dr. R. W. Shufeldt, U. S. A., Remarks on the patella; Mr. Romyn Hitchcock, Exhibition of specimens of Orbitolites, with notice of Dr. Wm. B. Carpenter's investigations.

Papers read by title: Mr. Robert Ridgway, Descriptions of some new North American birds. Description of a new American Kingfisher. Note on *Psaltriparus grindæ* Belting. Note on the generic name Calodromas. Mr. Leonard Stejneger, Diagnosis of new species of birds from Kamtschatka and the Commander islands. Dr. T. H. Bean and Mr. H. G. Drexel, Diagnosis of three new species of fishes from the Gulf of Mexico. Mr. G. Brown Goode and Dr. T. H. Bean, A new genus of Pediculate fishes.

March 22.—Communications: Col. Marshall MacDonald, Exhibition of charts showing natural and restricted river distribution

of the shad (by special request); Dr. R. W. Shufeldt, U. S. A., Remarks on the patella; Mr. Romyn Hitchcock, Exhibition of specimens of Orbitolites, with notice of Dr. Wm. B. Carpenter's investigations; Professor C. V. Riley, Personal reminiscences of the late Dr. George Englemann; Mr. William H. Dall, Exhibition of corals from Alaska, with descriptions of new species; Mr. Richard Rathbun, Exhibition of a peculiar growth of coral from Key West, Florida; Dr. M. G. Ellzey, The prepotency of the male parent; Dr. Leonard Stejneger, Exhibition of specimens of the great Kamtschatkan sea eagle, *Haliætus pelagicus.*

New York Academy of Sciences, March 10.—The following paper was presented: Recent visits to the "Singing Beaches" of Scotland and America, by Professor H. Carrington Bolton.

March 17.—The following papers were read: Notes on a visit to some of the snow-peaks of Oregon, by Professor John S. Newberry; Observations on the geology of the vicinity of Golden, Colorado, by Dr. N. L. Britton.

March 24.—The following paper was read: The topography of Egypt between lat. 28° and 30°, from original surveys made in 1882 and 1883, with especial reference to the erosions (—200 feet of the Reian and Qerûn basins, and the natural eminences (+950) feet) and the pyramids (+650) in, at or near the storage-reservoir of Pithom-Moeris (with lantern illustrations), by F. Cope Whitehouse, M.A., etc.

Boston Society of Natural History, March 5.—Professor A. Hyatt discussed the origin of the tissues, spermatozoa and eggs among sponges (Metazoa), and the habit of cellular conjugation, from the Protozoa. Dr. M. E. Wadsworth read a paper on the structure of the earth's interior.

March 19.—Mr. S. Garman spoke on the use of polynomials as scientific names; Dr. C. O. Whitman discussed the origin of the vertebrates; and Professor G. L. Goodale read a paper on certain vegetable monstrosities.

Appalachian Mountain Club, Feb. 13.—Professor W. G. Farlow read an account of some of the diseases and deformities of trees in the White mountains; Mr. C. E. Ridler described a trip to Prince Edward island and Blomidon; and the following papers were read: Mountain adventures by Sig. Alessandro di Placido, including a winter ascent of Fujiyama, Japan, as communicated by him to Samuel Kneeland, M.D.; A winter ascent of Mt. Adams, by Mr. W. H. Pickering.

Feb. 20.—Rev. John Worcester described some of the mountain views of Sinai and Palestine, illustrating his remarks with sixty or more lantern views.

March 12.—Mountain adventures by Sig. Alessandro di Placido, including a winter ascent of Fujiyama, Japan, as communicated by him to Samuel Kneeland, M.D.; a paper by C. H. Ames, entitled, The mountains near Ktaadn iron works, Me., was

to be presented; there was also read a paper by Samuel Kneeland, M.D., entitled, A visit to the crater of Vesuvius at night in April, 1882.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Dec. 20.—Dr A. J. Parker called attention to a previously unnoticed mode of reproduction in *Amphileptas fasciola.* One end broke up into amœboid particles, while the remainder, with its cilia, was active The creature afterwards resumed its original form. The Rev. Dr McCook spoke of the occurrence of *Formica rufa* in Dakota. In the center of the mounds was a mass of small twigs, forming a ball some eight inches in diameter, and galleries run downward from this for four or more feet. As the material of the nests is largely composed of vegetable fragments, prairie fires burn them out, forming large cavities.

January 10, 1884.—A paper by Miss Foulke, describing the reproduction of *Clathrulina elegans*, was read. Professor Lewis exhibited a mass of cast-iron which contained crystals of graphite, which again held particles of cast iron. The mass contained also pieces of unaltered anthracite. The presence of such pieces of coal, unconsumed through lack of oxygen, was considered to illustrate the way in which carbon may exist in meteorites or chalcopyrite in trap. Dr. Sharp stated that he had determined the presence of so-called retinal cells in the mantle of many lamellibranchiata, including Mya and Ostrea. The structure was the same as that of the primitive eyes of *Solen ensis* previously described. The relation between these eyes and those of Medusæ could scarcely be traced. At the previous meeting, Dr. Leidy called attention to specimens of tin ore from the Black Hills, and stated that he had been informed that a large quantity of such ore existed.

Jan. 16.—Dr. Leidy, in the course of remarks upon the life-forms thrown up at Atlantic City by recent storms, noted the presence of the holothurian *Caudina arenata.* This was probably the first recorded occurrence of this species on the New Jersey coast. Examples six inches long were found. Professor Heilprin, speaking of the Tertiary formations of the Atlantic coast, stated that the Vicksburg beds were, as determined by Conrad, probably of the same age as the Mayence basin, as *Orbitoides mantellii* was characteristic of both and of Oligocene beds generally. The strata immediately beneath the Vicksburg rest on strata which are the equivalent of the *Calcaire grossier* of France and contains Zeuglodon remains. In the Grand Gulf beds of the far south of Alabama, Mississippi and Louisiana, no determinable invertebrate fossils had been seen. The Jackson beds probably extend farther up in Mississippi than had been supposed by Hilgard. Remarks upon the abundance of chaplets of eggs of Fulgur during the winter led Dr. Leidy to state his belief that they are laid in winter and cast up by the spring storms.

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THE THEORY OF A GLACIAL DAM AT CINCINNATI AND ITS VERIFICATION.

BY PROFESSOR G. FREDERICK WRIGHT.

IN prosecuting investigations upon the boundary of the glaciated area in the Ohio valley, one of the most interesting facts brought to light is, that the true glacial drift is found on the Kentucky hills a few miles south of the Ohio, opposite Cincinnati. Granitic boulders, striated pebbles, and till are found all over Brown and Clermont counties, in Ohio, down to the margin of the Ohio river, where they cease. Nothing of the sort is found on the hills in Bracken county, Ky. But on crossing the river from New Richmond in Clermont county, Ohio, to a point in Kentucky near the boundary of Kenton and Campbell counties, glacial drift at once reappears upon the south side of the river at about an elevation of three hundred or four hundred feet, covering the hills for two or three miles back from the river. Till several feet deep here occurs, containing numerous granitic pebbles and small boulders and excellent specimens of striated stones, whose native place is not far north in Ohio.

I did not personally go over the hills in the northern part of Campbell county, but did explore Northern Kenton and Boone counties with considerable minuteness, and found glacial deposits extensive over the northern part of Boone county as far south as Burlington. About three miles east of Burlington, on the road to Florence, there is, for instance, a notable collection of boulders, of which I counted fifteen or twenty in the space of a few yards. These are in a shallow valley of Gunpowder creek, a small stream entering the Ohio near the southern part of the county. This clus-

ter of boulders was by my barometer 450 feet above the river, and the water-shed was at least a hundred feet higher. Two of the boulders are veritable specimens of the jasper conglomerate, so abundant about the outlet of Lake Superior. Granitic boulders and striated pebbles were also found at numerous other points over the northern part of Boone county, from Greenwood lake to Bellevue. Glacial accumulations also occur upon all points of the river north of this down to the river valley. It thus appears that from Moscow, in Clermont county, about twenty-five miles above Cincinnati, to Petersburg, Ky., about the same distance below Cincinnati, that is, for a distance of about fifty miles, the valley of the Ohio was for a short time during the glacial period filled with ice, forming an obstruction to the water at least 550 feet high. The water-shed to the west, between the Licking and the Ohio, is nowhere less than this height. Walton station, seventeen miles south and a little to the west of the water-shed, is 473 feet above the river, 913 feet above the sea.

Throughout nearly its whole extent the Ohio river occupies a narrow valley of erosion less than a mile in width, and from three hundred to five hundred feet in depth. There are enlargements in this trough wherever tributaries come in, either from the north or from the south, which also uniformly occupy valleys of erosion of corresponding depth, the width varying according to the size of the stream.

It is evident that during the continuance of this supposed glacial dam at Cincinnati, a narrow lake corresponding in depth to the ice-barrier, must have extended far up the Ohio and all its tributaries; among which may be specially noted the Licking in Kentucky, the Kanawha in West Virginia, the Allegheny and Monongahela in Pennsylvania. The difference between the levels of Pittsburgh and Cincinnati is about three hundred feet; so that a barrier of six hundred feet at Cincinnati would submerge the city of Pittsburgh to a depth of about three hundred feet.

It is also evident that if there was, for any considerable period such a glacial back-water dam as is supposed, there ought to be some evidence of it in the shape of terraces marking the old lake margin. Such evidence was not long in coming to hand, and it is all the more significant because furnished by independent parties. In March, 1883, I read a paper before the Boston Society of Natural History in which I reported the main facts just recounted

Upon seeing this report, Professor I. C. White, of Morgantown, West Va., situated in the Monongahela valley, and who has for many years been an active member of the Pennsylvania Geological Survey, informed me that the ice dam at Cincinnati was exactly what was needed to explain the terraces along the Monongahela. It appears that from Pittsburgh as far south as Fairmount, in West Virginia, a distance of 130 miles (which was as far south as Professor White had examined), the valley of the Monongahela shows signs along its edges of having been partially silted up with heaps of trash, such as clay, sand, gravel, boulders, drifted logs and other rubbish, brought in by its tributaries from higher land. The striking peculiarity of these terrace deposits is, that they "suddenly disappear at an elevation of 1050 or 1075 feet above tide; not a single rounded and transported boulder ever being found above that latter horizon, though occurring in countless numbers below this level. The hills above the river often rise three hundred or four hundred feet higher than the upper limits of the deposits, so that there can be no mistake about the elevation at which the terrace deposits disappear. * * Back from the channel of the river, especially where the surface configuration would make quiet water, there occur thick deposits of very fine, bluish-white clay in which great numbers of leaves are most beautifully preserved. This deposit is purest near the upper limits of the terraces.

"In the vicinity of Morgantown terraces of transported material occur at the following approximate (measured by barometer) elevations:

	Feet above river.	Feet above tide.
First terrace	30	820
Second terrace	75	865
Third terrace	175	965
Fourth terrace	200	990
Fifth terrace	275	1065."

The deposits of the fifth terrace in this series are frequently found far inland from the Monongahela on the tributary streams. In such a deposit near Morgantown, called the Flats, and covering three or four square miles, wells have been sunk sixty-five feet without striking bed rock. This is 275 feet above the river and 1065 feet above tide.

Other tributaries of the Monongahela, along which Professor White "has noted the clay and other deposits of the fifth terrace,

are Decker, Dunkard, Whitely, Muddy and Ten Mile creeks, and in each case the deposits disappear at the same absolute level at which they cease along the river."

Professor Lesley informs us also that the terraces along the Allegheny and its tributaries, preserve this same absolute level.

Coming down to the Great Kanawha river, another branch of the Ohio, which drains an unglaciated region, Professor White finds water-worn boulder deposits disappearing at an elevation of from two hundred to three hundred feet above the present level of the stream. About fifteen miles below Charleston, West Va., there is a deserted river channel followed by the Chesapeake and Ohio railroad, which extends through Putnam and Cabell counties to the mouth of the Guyandotte, at Huntington. This deserted valley is from one to two miles wide, is two hundred or more feet above the Kanawha, and "is filled to a great depth with rounded boulders of sandstone, chert, cannel coal and other trash, which has plainly been transported down the Kanawha from above Charleston, so that it was clearly seen that the water of the Kanawha had once found an outlet to the Ohio by way of this valley," a distance of fifty miles.

During the summer of 1883, I explored a similar deserted channel a little ways further down the river, in Greenup county, Ky. This valley extends from near the mouth of the Big Sandy to Greenupsburg, a distance of about twenty miles, and is from one to two miles wide, is 220 feet above the present high-water mark of the river, running parallel with it and about two miles distant. This, like all the valleys in this region, is a valley of erosion, the hills rising on either side from two hundred to three hundred feet, and the bottom of it is covered with rounded pebbles of quartz and quartzite, from an inch to two feet in diameter.

Coming to the Licking river, in Kentucky, Mr. G. H. Squier informs me that near Owingsville, Bath county, in the angle between Slate creek and the East Fork of Licking, there is an extensive low tableland which is covered by erratics, including numerous water-worn fragments of sandstone and coal, which must have been brought down from the coal fields twenty miles or more to the north-east, and could not have been scattered around as they are over this immediate tableland and the low hills adjoining it, except there had been an extensive body of still water occupying the area. This is just what would have been produced

by the glacial dam which I have supposed to have existed at Cincinnati. The facts had so impressed Mr. Squier that before knowing of my discoveries he had come to the conclusion that there must have been some such barrier as I have supposed. (See *Science*, Sept. 28, 1883.)

Strong as these confirmations are, it is important that the hypothesis of an ice dam should be verified by much wider observations in the field. All along the Ohio river, and in all its tributaries above Cincinnati, there should be found numerous facts, explicable only by this theory; while the absence of terraces of a corresponding level upon the eastern side of the Alleghenies, to which Professor Lesley has called attention, excludes the hypothesis that these high terraces in the Upper Ohio are due to a general Champlain subsidence.

Nor must the phenomena below Cincinnati be overlooked. During the summer of 1883, I continued my investigations into Southern Indiana to the Illinois line in Posey county. But I will not here speak in detail of the results attained. The problem of determining the southern limit of the glaciated area of this region, however, has been complicated by what I supposed to be the results of the Champlain subsidence, amounting to five hundred feet or more in the Mississippi valley. Here, for the first time in my western investigations, I have encountered the loess overlapping and intermingling with the terminal deposits of the glaciated area in a very interesting and puzzling manner. I hope during another summer to get additional light upon the subject. Meanwhile, I am anxious to obtain any information or instruction which the experience or wisdom of other investigators may be able to furnish me.

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THE STRUCTURE OF THE TRACHEÆ OF INSECTS.

BY PROFESSOR G. MACLOSKIE, D.SC., LL.D.

I. Historical.—Blanchard's theory of two tracheal membranes with an interposed spiral thread, and of peritracheal circulation, though it was accepted by Louis Agassiz and some other authorities, may be set aside as obsolete. It was well refuted by Joly; and Claparède, in refuting its author's cognate theory of a complex

vascular system in spiders, showed that in both groups the circulation is essentially lacunar.[1]

Recent investigation has established the doctrine that the tracheæ and also the trachea-like salivary ducts are chitinous products of ingrowing processes of the epidermis. Bütschli deems them segmental paired invaginations of the epidermis, while Weismann finds that the tracheal wall is an intima secreted by ingrowing rows of cells, just as the chitinous cuticle is secreted by epidermal cells.[2] These discoveries are of fundamental importance, and must underlie the true theory of the nature of tracheal structures.

The views of some other investigators seem to me not so well established. Meyer, for example, finding that the intima (the name here used to designate the chitinous wall of the tracheal arises as a homogeneous membrane, holds that it subsequently splits so as to give off a spiral thread, and that the larger trunks have a double membrane external to the spiral.[3] Carl Chun supposes that the spiral thread is a true chitine layer, and not merely a thickening product of the intima, and superadds a splitting of the intima into a double membrane.[4] C. S. Minot represents the spiral filaments as solid threads imbedded in the substance of the chitinous intima, and adds some good observations as to the spiral threads (sometimes two to five or six together) ending after a few turns round the trachea, "the single threads terminate not abruptly but by tapering down to a point and so disappearing." None of these observers seem to see, much less to grapple with the difficulty of conceiving how the spiral filament or anything else can be formed external (morphologically) to the chitinous secretion of the epidermis, or how such chitinous outgrowths can split after they are once formed.

2. *Pseudotracheæ of Muscidæ.*—In examining the proboscis of

[1] Blanchard in *Ann. d. Sci. Nat.*, Ser. 3, Vol. IX (1848), and *Ann. and Mag. Nat. Hist.*, Ser. 1, Vol. XX. Joly in *Ann. d. Sci. Nat.*, Ser. 3, Vol. XII (1849). Agassiz in Proc. Amer. Ass. Adv. Sci., 1850. Claparède in *Ann. d. Sci. Nat.*, Ser. 5, Vol. II (1864).

[2] *Zeit. f. Wiss. Zool.*, XIII, XIV, XVI (1863–1866, Weismann), XX (1870, Bütschli).

[3] *Zeit. f. Wiss. Zool.*, I (1848).

[4] Inaugural dissert., "U. d. Bau u. der Rectaldrüsen b. d. Insekten," Frankfurt, 1876.

[5] U. S. Entomol. Comm. on Locusts, Report II, p. 192 (1880), and *Recherches histologiques sur les trachées de l'Hydrophilus piceus*, in Archiv. de Physiol. Exp. 1874

the housefly, some years ago, I made a discovery, the important bearings of which were easy to appreciate; but I did not refer to it in the paper then issued, as I wished to test it more fully. I found that the scraping-tubes (pseudotracheæ) of this organ are flanked by chitinous thickenings of the cuticle, that these thickenings are enfolded or wrinkled so as to resemble the C-like semitubes which serve as an inner skeleton for the pseudotracheæ. The enfolded parts can be flattened out with the needle, and when liberated they at once spring back to their normal crenulated condition (Fig. 1, C). This suggests that the *pseudotracheæ* (P) *are likewise thickened crenulations* of the chitinous membrane with which they are continuous.[1]

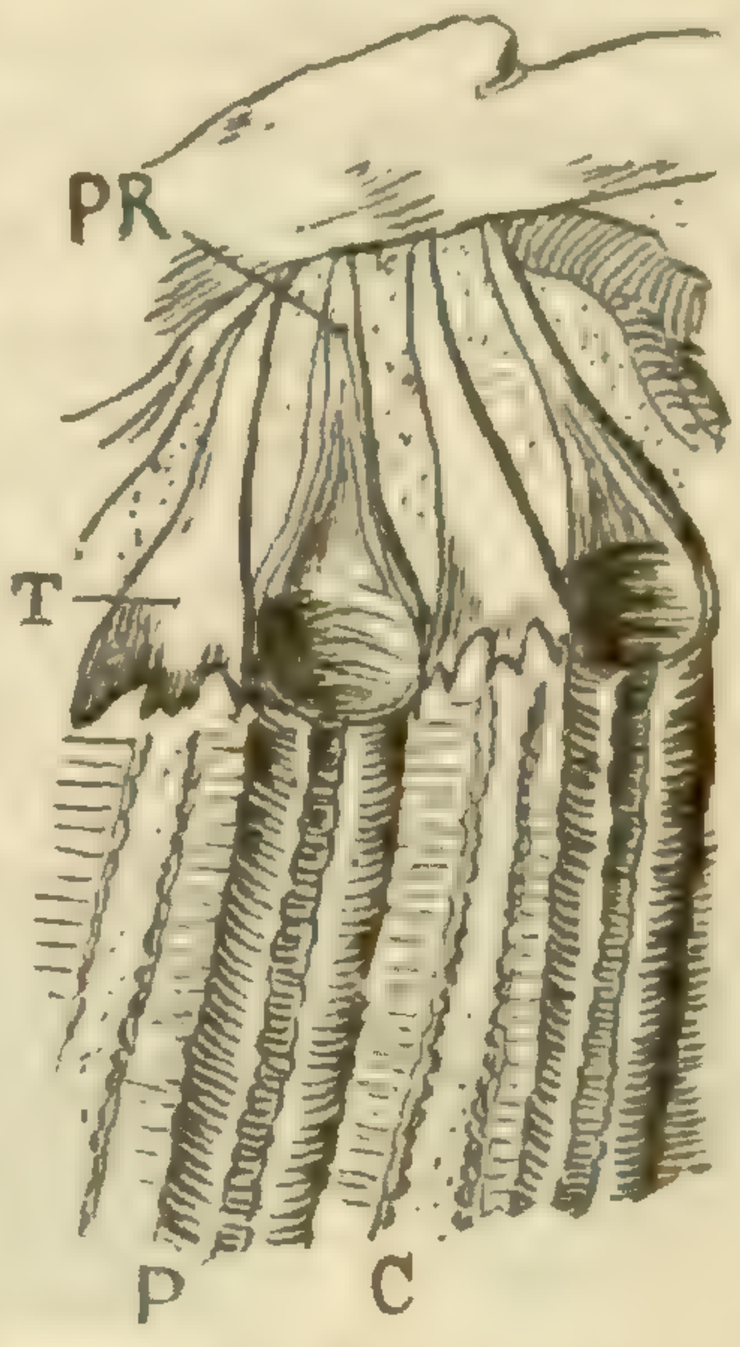

FIG. 1.—From distiproboscis of housefly (*Musca domestica*). P, two pseudotracheæ, with (C) bordering crenulations, and (T) two teeth, PR, basal roots of two pseudotracheæ, inserted in a transverse bar.

This doctrine receives unexpected support from Kraepelin's elaborate paper, just published, on the proboscis of Musca.[2] Kraepelin accepts the views published by myself, and confirmed by Dimmock, as to the general structure of the proboscis, at the same time adding largely to our knowledge of the anatomy of its parts. He also adopts the explanation of its protrusion by the injection of air. He has made the curious discovery that the teeth (T) planted between the roots of the pseudotracheæ, and likewise that these roots themselves, are formed by secondary foldings of the membrane. If he had followed out this observation he would have come to the conclusion that the entire pseudotracheæ, being crenulatious at the outset, are so throughout. This is the conclusion that I formerly reached, as stated above, from an independent line of investigation, and hence I may take it as proven that these structures, so long a subject of interest, have now found their true explanation.

[1] For a description of these parts see my paper on the "Proboscis of the Housefly," AMER. NATURALIST, 1880, p. 153.

[2] Karl Kraepelin, Hamburg. "Zur Anatomie u. Physiol. des Rüssels von Musca," with 2 plates (1883). His figure has three rows of 2-cusped teeth, and probably is drawn from the blowfly (*M. vomitaria*), whilst mine is from the housefly, which has only one or two rows of 3-cusped teeth.

3. Wall of Tracheæ.—This discovery leads to wider results. The pseudotracheæ so closely resemble the salivary duct and the proper tracheæ that all these structures have been frequently confounded together. The pseudotracheæ being surface-productions are open externally by a longitudinal slit. The salivary duct and proper tracheæ, being internal structures, do not admit of a lateral fissure, but they are ingrowths from the surface, and are morphologically of the same nature as the pseudotracheæ. Hence we may expect them to be produced on the same principle. If the pseudotracheæ are demonstrated to be thickened crenulations of the external cuticle, we are led to ask whether the spirals of the proper tracheæ and of the salivary duct are not crenulated thickenings of the intima.

The fragment of a trachea of a centipede (Fig. 2) bears out this interpretation. Above A is a rent with a small fragment of the membrane supporting relics of spirals, which are probably crenulations of the membrane, gradually losing themselves below. This is very unlike what would appear if the spirals were independent structures. Whenever the spiral separates from the membrane the separation is artificial, as the membrane is easily rent. We never find here what is common in plants, the spiral unrolling with the membrane remaining intact. In fact, membrane and spiral here appear to be continuations of each other, the membrane thickening and turning in to form a fold, somewhat after the pattern of the bellows of an accordeon. Minot's observations about the spirals often coming away, several together, and about their tapering down to a point and gradually disappearing, find their explanation in this. At the origin of branches (Fig. 2) the arrangement of the spirals agrees with this view rather than with the supposition of independent threads, and is identical with the pattern of branching at the "catch-drain" of the pseudotracheæ, which we have shown to be crenulations.

FIG. 2.—Part of trachea (centipede) with origin of branch.

A result of this explanation is, that the spirals themselves are fine tubules, externally opening by a fissure along their course.

They are so minute that we need not be surprised if direct observation has hitherto failed to detect this structure. A cross section of them in my possession (prepared by W. M. Rankin) seems to me to confirm this view; but the outside diameter of the spiral is only .0025^{mm} (about a twenty-thousandth of an inch), and interferences by diffraction lessen the value of direct observations except as to general outline.[1] I think that I can also see evidence of a lumen within the spiral, and of the fissure, in stained specimens of tracheæ prepared in the usual way.[2] Carl Chun's figure, though not so understood by its author, is in accordance with our view (Fig. 3). What he supposes to be solid fibers cannot arise in the way suggested by him, inside and independently of the intima, which is really the boundary of the insect's body. The connecting membrane (M) after reaching the spiral (which is probably hollow) bends in, becoming in fact the wall of the spiral, and on returning to the surface beyond the fissure, is continued as a connecting membrane to the next spiral. What he regards as a superficial ridge on the spirals is here supposed to be the optical expression of the external fissure. I think I have also got the explanation of the "outer membrane of later origin" represented at M^2. It is the first appearance of a new intima prepared to replace the functioning one after the process of molting.

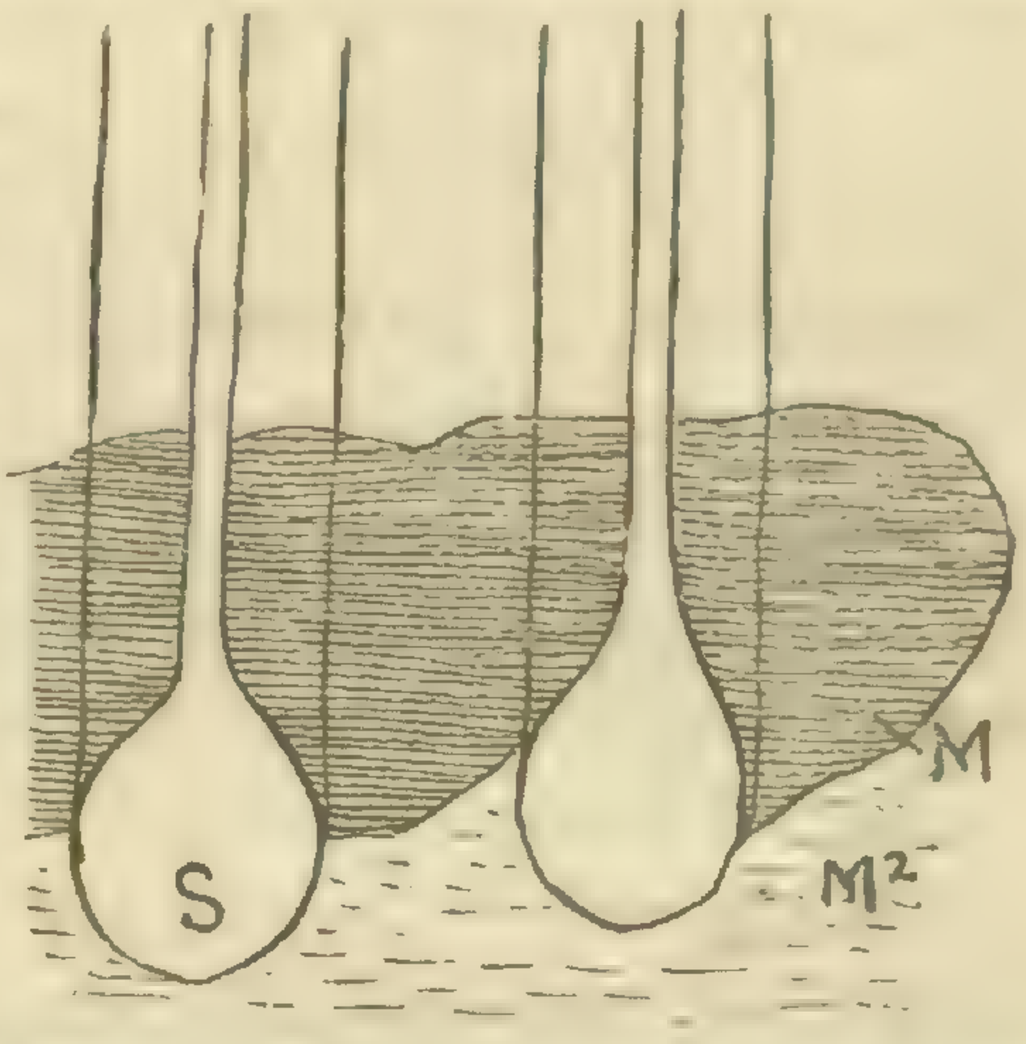

FIG. 3.—Cross-section of two spirals (S) from larva of Eristalis. M, a fragment of connecting membrane; M^2, outer membrane of later origin. After Chun.

The mode of genesis of the spirals has been found by different observers to be first by the formation of homogeneous membrane. This condition persists in fine branches and also in large air-sacs (in these, however, striation is usual). The homogeneous membrane soon becomes transversely striated by incipient crenulation. In a larva we can easily see new tracheæ in the striated condition

[1] The margin of what I take to be their lumen appears to me too sharp to be explained by refraction in solid fibrils.

[2] In stained specimens viewed, as Fig. A, the circle of light at the margin of the spirals is so bright and well defined as to indicate an inner cavity.

enclosing older ones with well-developed spirals; a tube inside of a tube, the contrast between striæ and spirals indicating the course by which increasing crenulation with thickening is turning the smooth membranous tube into the definitely strengthened trachea.

4. Mode of Aëration.—The chitinous walls of the tracheæ are supposed to permit the transmission of air to the surrounding blood, but not the passage of fluids. If we bear in remembrance that the air within them is dry (*sc.*, not dissolved in any fluid), I suspect that the direct passage through the wall is imaginary. Gegenbaur thinks that the fine extremities of the tracheæ may play some part in the function of aëration, and a consideration of the terminals of the tracheal branchlets may well make us ask if they do not perform the chief part. Boudet has fixed the seat of the respiratory movements in the abdominal nerves, and therefore in the abdominal muscular movements.[1] As the abdomen expands and contracts, the tracheal trunks rhythmically enlarge and diminish, causing inspirations and expirations of air; a partial vacuum and pressure being alternately produced around the trunks. The structure of the spirals indicated above explains what was long a mystery to me, how chitine, which is flexible but not tensile, can secure the enlargement and reduction of volume essential to a tidal movement of air. The opening and closing of the spiral crenulations, with widening and narrowing of the external fissures, respond to the oscillations of pressure, and hence the variations of volume and the movements of air.

The air reaching the numerous branchlets of the tracheæ, supplies directly all the important tissues, the digestive canal, glands, nerves, limbs, eyes, mouth-parts, &c. The branches have no chitine at their extremities, enter directly into what L. Agassiz described (*loc. cit.*) as "bags, which when highly magnified look like small lungs; the branchlets losing the spiral thread when they enter these lungs." Weismann describes and figures these terminals as long spindle-cells having a fine elastic intima within them; and states that in the young larva they are filled with air. Max Schultze has shown how in the glow-worm (*Lampyris splendidula*) the terminal cells of the tracheæ are stellate, and are abundant at the fat-bodies which by a process of slow combustion

[1] *Ann. d. Sci. Nat.*, Ser. 5, Vol. II (1864).

cause luminosity (Fig. 4). It may be pertinent to cite Quatrefages' description of the luminosity of some marine animals.[1] I have observed that the light flashes in jets along the somites of these worms as if the segmental organs had something to do with its production and with the function of respiration. I have also shown that in the housefly the air-cells in the proboscis expand at each act of respiration.[2] It would thus appear that during inspiration the air is driven into the tracheal end-cells, as into the chambers of our own lungs, and that in this way the tissues are directly aërated. The slower process of aëration by the intervention of the blood may suffice in some larvæ, as in Crustacea, but the chief function of the blood of insects seems to be the conduction of food from the intestinal walls to the various organs.

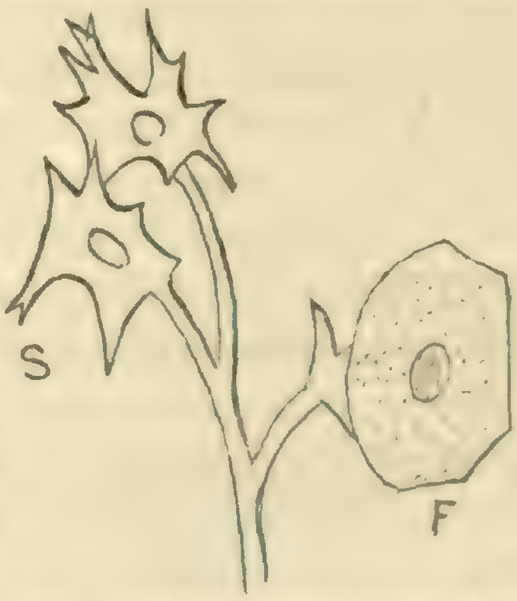

FIG. 4.—Stellate terminals (S) of tracheæ; F, luminous fat cells. After Schultze.

To sum up. The tracheæ of insects and similar organs are supported by chitinous fibers which are crenulations accompanied by thickening of the chitinous intima with which they remain continuous; their dorsal fissure and flexibility providing for the enlargement and reduction of the cavity; and the oxygenation of the tissues has its seat chiefly at the extremity of the tracheal branches, and not by diffusion from the tracheal trunks into the blood.

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AGRICULTURAL BOTANY.

BY E. LEWIS STURTEVANT, M.D.

THE secret of classification consists in the understanding of the motive, of which form and structure are exponents. The natural motive of plants is to secure existence and perpetuation, and parts and habits are and have been so formulated as to compass this object as against difficulties of very varied character. Each individual plant is in a state of unstable equilibrium, ever

[1] *Ann. d. Sci. Nat.*, Vol. XIX (1843).
[2] *Psyche*, No. 100 (Aug., 1882).

tending in the direction of least resistance, and so modifying its own nature as to become better fitted to meet such resistances as cannot be avoided. Each change is subject to transmissal through heredity, and thus through successive accretions, "Holding the gain and answering for the loss" plants become so differentiated as to react favorably with their environment, and in the course of time most numerous forms are established, each expressing the common motive in changes designed to meet a complex environment in which the various factors are of greater or less dominancy. The necessity for a constant struggle for perpetuation, as nature's law is, has made the reproductive organs paramount as expressing the method in which the plant-motive has been fulfilled, and hence the reproductive organs are dominant with the botanist for the purposes of classification, and the beautiful natural system of botany has become recognized as a science.

We have, however, a class of plants in which another motive than that of survival has become dominant, and in which the reproductive organs have become subservient, and this because under the protection and guidance of man, the necessity for the struggle for existence has been removed, and the plant has been left free to respond to new motives which have been impressed upon it. Our domesticated plants exist for man's service, not for their own, and accordingly such have developed away from nature's requirements towards man's requirements. The removing from a plant the necessity of warfare, and the substituting the conditions of peace and plenty, modifies such plant to some degree, but when in addition the motive is brought to harmonize with the desires of man by means of the process of selection, plants become profoundly modified in form and habit, and a parallelism of form is obtained which well illustrates the dominancy of the new motive. Thus the wild cabbage has furnished various divergent forms, and these forms in themselves resemble other forms which occur in plants of different species, genera and even natural orders. We have parallelism of form between varieties of the kale and parsley (dwarf curled kale and early cut-leaved parsley), the cabbage, lettuce, chicory, etc. (Tourlaville cabbage, cabbage-lettuce, scarole en cornet), the cabbage and the chard-beet (Pak-choi cabbage, white-leaf beet) according as the motive has been for leaf, head or stalk. This parallelism is to be seen in various others of our domesticated vegetables.

Just as the dominant motives in nature have secured fixity for types, so the dominant motives under art have secured fixity of type, but as the motives differ, so do the types differ. Hence natural botany cannot serve to secure classification for plants which have become domesticated, and for these latter we require a new botany, which we may call agricultural botany, and which must be devised alike in its principles with natural botany, but divergent in its methods of application in accordance with the divergent plant-motives.

In agricultural botany as in the natural botany, heredity must be considered in arrangement, for a true classification must deal with the totality of plant structure, form and motives, yet while in natural botany the reproductive organs, the expression of the paramount motive given to the plant by nature, must be considered paramount for the purposes of classification, in agricultural botany form must be considered as paramount as representing the paramount motive supplied to the plant by man. In the natural botany, species, genera, orders and classes represent stages in the development under nature, in the agricultural botany successive changes in selection represent stages in the life history of the new plant.

Premising that our remarks will be understood to apply to agricultural plants alone, we can illustrate our position by outlining a classification for roots.

When a wild plant is brought, through its seed, to the garden, and grown in rich soil and protected from weeds, the change in size of the root may be at once manifest, and the root may be smoother and less branching than in the plant under natural conditions, but the type of form of root remains the same even under many years of continued cultivation, unless modified by the process of selection. These protected, yet not domesticated roots, have this feature in common: the diameter of the root in its upper portion does not exceed the diameter at the stem and leaf insertion. Examples are the Scorzonera, salsify, Scolymus and horseradish. Fig. 1, Scolymus, and salsify, represents the type, of which salsify is at the farthest remove towards improvement. These plants become feral without change in the type of root.

Passing now to domesticated roots, we find two separate classes of selections with, in some measure, like selections within both. The first includes the tap-rooted forms, the second the caudate

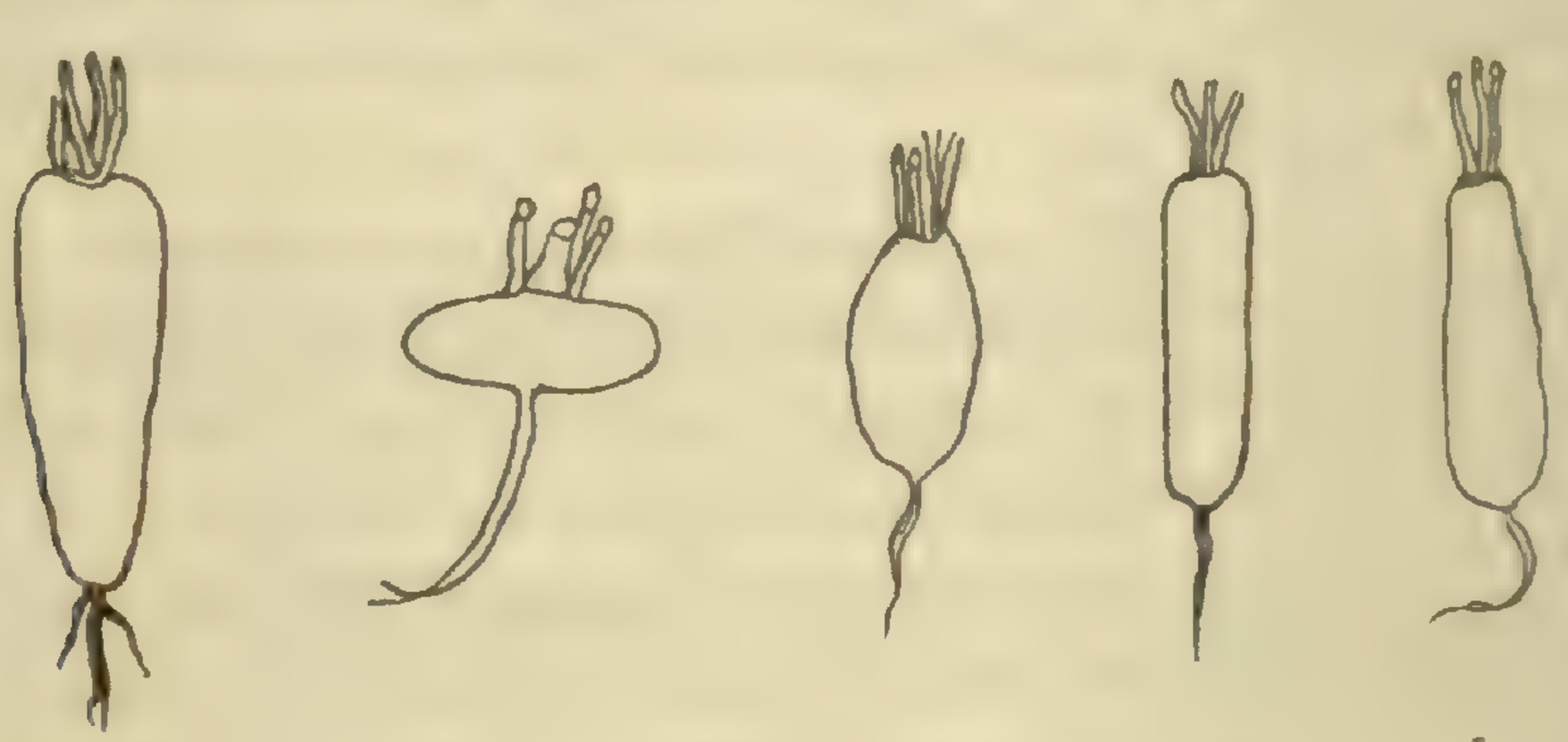
forms. The parsnip is so little domesticated that its root-forms in general come within the first class, while the beet, carrot, turnip and radish present forms which can be referred to both classes.

Scolymus. Salsify.

FIG. 1. FIG. 2.

The first stage of the domesticated root is, that the upper portion of the root has a diameter in excess over that of the stem, and Fig. 2 represents the type of tap-rooted forms, in which the bulbous portion may be cone-form, cylindrical or almost globular, but in all cases the swollen portion tapers into the root.

The second stage of the domesticated root is the caudate, wherein, regardless of the form of the swollen portion, the root starts abruptly from a flattened surface, and gives a caudate appearance. The sub-stages within this stage represent the highest and most improved forms, and are represented in Fig. 3; *e*, or the tankard-



a *b* *c* *d* *e*

FIG. 3.

shaped, being the mark of extreme domestication, and each one of the types figured standing for the motive impressed upon the plant through conscious selection, and widely divergent from the forms which appear in nature as having no relations of advantage with and for the feral plant.

On account of the inter-relations of the two botanies, brought

about through the hereditary relationships of plants, the wild plant being the progenitor of the cultivated, it becomes essential to employ a symbol whereby agricultural relationship may be expressed without expressing conclusions as to botanical relationship as true species. A * placed after the generic name is what I propose. Thus *Tragopogon porrifolius* would be the scientific name for the salsify in Fig. 1; *Daucus * carota* for the cultivated carrots in all their forms, in order to distinguish them from the wild carrot, *D. carota*, etc., and ultimately a name for each stage or sub-stage of selection which has acquired fixity of type, as *D. * acuminatus*, the tap-rooted or stage 1 carrots, *D. acuminatus teretus*, the cylindrical tap-rooted carrot, etc., and within each of these agricultural forms, the varieties therein belonging to be grouped and described. It is thus seen that every type of cultivated plant-form which possesses constant characters under continuance of man's protection, and which differs from other type forms, would form an agricultural species; and that the same specific name would serve with the various genera of plants that have been forced to assume the same motive in development of form, as *Daucus * acuminatus teretus*, the cylindrical tap-rooted cultivated carrot, *Raphanus * acuminatus teretus*, the cylindrical tap-rooted cultivated radish, etc.

In the preliminary work in a new science much in the beginning must be provisional in its character, and hence we have selected for illustration a well-defined group of roots, leaving for later consideration the fascicled forms, as occur in the sweet potato and skirrit, as well as certain forms not as yet sufficiently studied. We but seek at this time a presentation of our views in order to invite discussion, and to secure coöperation, if our attempt is justifiable, from botanists whose studies include horticulture in its various branches; for if we are correct in our reasoning, the system, whose keystone is motive, must necessarily be applicable to all forms of changes produced by man's interference with nature. Of one thing we are assured through trial, that by using the motive given to the plant by man as furnishing data for classification, and by the study into the historical or probable sequences and stages of selection, we are enabled to form logical divisions and subdivisions in our garden forms, whereby identification of varieties by description has been furthered, and thus the study of domesticated plants in their economic relations has been rendered more easy for us to pursue.

THE NATURALIST BRAZILIAN EXPEDITION.

Paper III.—São João do Monte Negro.

BY HERBERT H. SMITH.

(Continued from page 470, May number.)

THE large Felidæ are now rare near São João, but individuals of all the species are still occasionally met with. The *Felis onca*[1] here roams indifferently in the highland or lowland forest; occasionally it attains a length of eight feet from the nose to the root of the tail, and in fierceness and strength it is probably not inferior to a lion. This species is characterized by black spots arranged in groups or circles of five or six each, on an ochre or tawny ground. Throughout Brazil there are two other species which heretofore appear to have been confounded with this one by naturalists. The first is the *onca pintada*, *Uriauara* or *onca cachorro* of the Amazons. This is quite as large as the true *onca*, and higher and thicker in proportion. The skin is readily distinguished; the colors are nearly the same as in the *onca*, but the spots are smaller and scattered evenly—never arranged in groups. The other species is the one which is known everywhere as the *tigre*, or black tiger. It is even larger than the others, the skin being of a deep glossy brown-black, marked with still deeper spots which are arranged as in the true onca. The skin of these three species can always be readily distinguished, and the hunters, who, in such cases, are the best judges, declare that the mothers give birth to cubs which are similar in pattern and coloration to themselves. Very rarely, it is said, crosses between two of the kinds are seen, and it is possible that skins of these crosses, appearing in European museums, have caused the confusion of species.[2]

The puma, or *leao*, as it is called here (*Felis concolor*), is smaller than the *onca*, and more common; it kills sheep and calves, but never attacks a man unless driven to bay. The hunters speak of several varieties, but do not regard them as distinct species. The puma does not cross with the three preceding kinds.

[1] Called here simply *onca*, or *jaguara*; on the Amazons, *Yauara sororca*; in Matto Grosso, *Cangussú*. On the Amazons this species belongs properly to the flood-plain, while the *Uriauara* is exclusively a highland form.

[2] Prince Maximilian very clearly indicates the three species, but supposes that they may be varieties.

The *jaguaritica*[1] is a spotted cat, smaller than the puma; it appears to be allied to the *F. onca*, but the spots tend to run into longitudinal stripes, and the animal is never more than five feet long. Two still smaller spotted kinds are known here, one of which is marked much like the *jaguaritica*, but on a grayish instead of a yellowish ground; the other has small black spots on an ochreous ground.

Finally, there is a gray, unspotted species,[2] not much larger than the domestic cat. All these small species are readily tamed if taken young. We had a *jaguaritica* kitten in the house for several weeks. When brought to us it was as large as a three-months-old domestic cat, and its eyes were not yet open. It soon learned to feed from an ordinary nursing bottle, and it became very affectionate and playful, following us around, and climbing into our laps when we sat down. Its cry was like that of a domestic kitten, but shorter and sharper. We had hopes of rearing it and carrying it to the United States, but after awhile, without any visible cause, it sickened and died.

Foxes appear to be exclusively confined to the high prairies; I believe that the differences of color shown by individuals are only varietal. A kind of wild dog is found in the forest, but we did not obtain specimens, and I am unable to judge whether or not it is merely a form of the domestic dog which has run wild. The *Mao pellado* (literally bare-handed) is a reddish-brown dog-like animal, one of the commonest mammals of this region; the legs are long, and on the lower part have only very short, scattered hairs, whence the name. It is nocturnal, wandering on the ground in woods and ravines, and occasionally visiting cornfields to devour the tender ears. It also eats nestlings and eggs. Two

[1] *Onca vermelha* on the Amazons; *Pardo* in Matto Grosso. Called also *Suacurana*, a Guarany name meaning false deer.

[2] The two smaller spotted species and the gray one are called indiscriminately *gato do matto* or forest cat in Rio Grande do Sul and in Matto Grosso. On the Lower Amazons the small spotted species are termed *maracajás*, and only an uniformed kind is named *gato do matto*.

I have not attempted to name the species, partly because, writing in the field, I have no books of reference at hand, and partly because the nomenclature is still in confusion. There will, of course, be much difference of opinion as to what constitutes a species among these Felidæ, but so long as the various forms can be readily separated, and do not ordinarily cross with each other, it appears better to regard them as distinct. Whether they are "species" or "races" or "varieties" is a question of very little importance.

cubs are generally produced at a birth. The *Mao pellado*, if taken young, may be domesticated, but it never becomes thoroughly tame; it has a very strong, disagreeable odor, which makes it an undesirable pet.

Of the *Coatis (Nasua)* two species are found here as in other parts of Brazil. The larger, called *Coati-munaê*,[1] resembles a raccoon, but stands rather lower, and is readily distinguished by its long snout; the *Coati-miry*[2] is smaller. Both are rather nocturnal in their habits, and rather frugiferous than carnivorous; two cubs are produced at a birth. Tame coatis are often seen, but as they are very mischievous and rather ill-natured, they are generally kept chained.

Two kinds of otters, the *lontra* and the *ariranha*, are occasionally seen about the rivers. The *lontra* appears to be identical with the Amazonian species of the same name. It never wanders far from the stream or river in which it lives, and when alarmed it quickly takes to the water, swimming at the surface and raising its head to stare at the intruder with a short bark. These otters, if taken young, become very tame, and they may be taught to bring in fish. I knew of one on the Lower Amazons which accompanied the village boys in their frequent baths, diving about with them and evidently enjoying the fun. The *ariranha* is much larger, and when swimming against the current it often advances by a series of leaps above the water; in this way it will distance a steamer. In Matto Grosso I have seen two of these animals keep before an ascending steamer in a swift river for more than an hour.

A small skunk is found along the borders of woods, but I do not think that it is properly a forest animal. Its habits are similar to that of the North American skunks, but though its scent-gland is well developed it is seldom used. On one occasion a living specimen was brought to us in a sack; we allowed it to run about the floor and found that it had hardly any unpleasant odor; even when we killed it, it did not attempt to use its characteristic defensive weapon. It may be that the gland only becomes active at certain periods.

Capivaras[3] are still common by the river-shore, where they

[1] In Guarany, literally the trap-coati; corrupted to *Coati-mundi* or *mundéo*.

[2] Guarany, little Coati.

[3] From the Tupy-Guarany *iaapê*, grass; *uára*, that lives in or among.

subsist principally on grass and leaves; they are very stupid and tame, and so heavy in their movements that it is no difficult matter to catch them alive. When pursued they generally take to the water, swimming with part of the head above the surface. I have frequently seen Capivaras running about with cattle, and in less populous districts they will allow a man to pass within a few yards of them without showing alarm. Living specimens are sometimes seen about houses, but they can never be thoroughly tamed. The skin is prized for making whips and cords; it has a black outer cuticle which scales off soon after the animal is killed, so that it is difficult to obtain a perfect specimen. The flesh is considered unfit for food, owing to its unpleasant flavor; but when the animal is skinned and cleaned soon after its death, this is not noticeable; the meat is then very good, as I can attest. The female Capivara is generally seen with several young, all of different sizes, though it is said that they have only one or two at a birth. If the common reports are true, conception must take place several times during gestation. An intelligent hunter assured me that he had found six fœti, all of different sizes, in the womb of a Capivara; the largest was on the point of being born, and he succeeded in keeping it alive for several weeks. I have heard similar stories from other quarters; but other hunters deny their truth, and say that from six to ten young Capivaras are produced at one birth.

Allied to the Capivara, and resembling it in form, are two small rodents, the *priá* and the *micó*, both found on the Campo; the latter, it would appear, extends northward as far as the River Parnahyba, but it is rare in Rio Grande do Sul, where the *priá* is common.

Pacas are the largest forest rodents, they are now rare in this part of the province, their excellent meat causing them to be sought after by the hunters. They are properly nocturnal, eating fruits and roots. Of the allied Cotias there appear to be two kinds here, and I am inclined to think that many species, differing in slight but constant characters, will be found in South America. The Cotias are diurnal, and subsist on fruits. Of other rodents we collected only a small blackish squirrel, a porcupine and a curious forest rat with a very elongated body; all of these are rare, and I could learn nothing of their habits. A small rabbit is found on the Campos, and there is a kind of rat

(*rato da taquara*) which occasionally appears in immense numbers, though it is generally very rare.

Tapirs, or *antas*,[1] are now very rare near São João, though they are common in the less settled parts of the province; in the equatorial forests of Brazil they are among the most abundant animals. They wander only in the high forest, coming to streams at night to drink and wallow; their food consists of leaves and fruits.

Tapirs are readily tamed, and they are rather affectionate and intelligent pets. A friend of mine once suffered a terrible fright from a tame tapir. He was passing the night at a Brazilian house where one of these animals was allowed to roam about at will. My friend slept in a hammock, whence, about midnight, he was very rudely ejected by a large animal which attempted to pass underneath him; as the hammock hung low, the animal's back acted on it like an earthquake, and the sleeper tumbled out. Awakened thus suddenly, he threw out his hands, to find them in contact with a rough, cold skin. A yell of terror brought the other inmates of the house, and the offending tapir was ignominiously dragged away; but my friend did not soon recover from his fright.

The two kinds of wild hogs found here seem to correspond with the species (*taiassú* and *caititú*) found on the Amazons and in Matto Grosso. Both wander in small droves, eating fruits and roots; they are seldom seen on the open lands, and when found there they quickly seek refuge in the forest. Once under the trees they are apt to show fight, facing the hunter and gnashing their long tusks. Their meat is very good.

Two kinds of ant-eaters, the large *Tamanduá bandeira*[2] and the medium-sized *Tamanduá pequeno* are found here; the first appears to walk only on the ground, but the *tamanduá pequeno* often climbs trees in search of ants' nests. The small nocturnal climbing species does not appear to be found here. In a wild state the tamanduás seem to feed only on termites and insect larvæ, but they may be tamed, and they will then eat rice and bread. We

[1] Our word tapir, the Latin *tapirus* and the French *tapir* come from the Tupy-Guarany name *tapiira* or *tapiir*. *Anta* in Portuguese means an elk.

[2] Banner ant-eater, in allusion to its broad, spreading tail, which it often holds over its back; on the Amazons it is also called *tamanduá-assù*, the great ant-eater. *Tamanduá* or *manduá* appears to be derived from the Tupy-Guarany *taá*, an ant, and *mundi*, a trap.

once kept a young *Tamanduá pequeno* in the house for two or three weeks, feeding it on milk, which it sucked or lapped from a saucer. It became quite tame, following us about awkwardly by walking on the sides of its feet; if allowed to do so it would climb to our laps, clinging tenaciously to trousers or skirt by holding the cloth with its strong hooked claws turned back on the palms. Though this specimen was a mere baby the claws were formidably strong, and after one or two trials none of us cared to trust our fingers to them. When first brought to the house it expressed its fear by short whines or grunts, and afterward it gave vent to similar cries when hungry. It was fond of heat, often stretching itself on the ground in the sunshine with all four legs wide apart. Like all young specimens this was much paler in color than the adults, approaching to yellowish-white. Occasionally old tamanduás are found with the same tint, and the hunters regard these as a distinct species, but I believe that they are albinic varieties.

Three kinds of armadillos or *tatús* are mentioned by the hunters in Rio Grande; of these we obtained two, belonging to different genera. The larger, which sometimes grows to a length of three feet, seems to be almost exclusively a feeder on carrion; it makes deep burrows, breaking the earth with its strong claws, and sometimes it is said digging into graves. The other is much smaller, never more than eighteen inches long, and it feeds on white ants, small fruits and so on; tame ones make most amusing pets, running about the house and poking their inquisitive noses into every crevice. This kind is eaten, the meat being white and very good; but it is a singular fact that dogs will not touch it. A still smaller *tatú*, sometimes seen here, is characterized by a truncated and somewhat hairy shell. All these species live in clearings, *fachinal* forest or open campo; never, I believe, in the main forest.

A large opossum is common in the woods, living in hollow trees and eating small birds, etc. It is strictly nocturnal, and apparently is quite unable to see during the day time; the hunters generally take it alive, carrying it by the tail. When tormented it hisses much like a goose, and tries to bite. It is exceedingly tenacious of life, living after its back bone and skull are both broken; I have even known one to live for some time, and attempt to walk and bite, after its heart was taken out.

A female opossum was brought to us with six well-grown young ones, as large as three weeks' old kittens; they clung to the mother's back, twisting their prehensile tails around hers, and apparently looking upon her as their protector; but during the succeeding night they all escaped through a hole, leaving the mother, who could not follow, behind. One or two small opossum rats are also met with; they climb over the small branches of trees and, like the large species, are unable to see in the daytime. I could learn nothing of their habits.

Passing by some less interesting species, I may here devote a page to our tame monkey, Bildad or Billy as we generally called him. This was a very small gray marmoset from Pernambuco, which I had bought of a sailor in Rio de Janeiro. Being much petted, and allowed to run about as he pleased, he became very tame; rather an unusual thing with this genus, for the marmosets are generally rather wild and timid. Even at his best Billy was somewhat fractious, always biting if we attempted to seize him, though he came to us readily enough if we offered a hand. He was especially attached to my wife, spending hours on her shoulder or on her head, his four arms spread out and his hands clinging fast to her hair; if she put her hat on over him so much the better, if neither head nor shoulder could be had he would crawl up a sleeve or under a vest, always turning to poke his inquisitive face out to see if we were observing him. When in a playful mood he delighted, as a child might, in a game of "peek-a boo," dodging from side to side behind a cushion and keeping up the game as long as anybody would dodge after him. About once a day Billy was seized with a wild spirit of fun and a tremendous romp took place. He would leap from one to the other, rushing over us from feet to head, snapping at our noses, pulling our eye-winkers, playing bo-peep from our sleeves and throwing himself on his back to bite his own toes in an ecstasy of enjoyment. Suddenly, in the midst of a rush, he would stop short, draw back the corners of his eyes, and make an indescribable face at one of his observers; seen for the thousandth time this always provoked us to shouts of laughter, whereat Billy would scuttle away and turn a somersault on the bed. Sometimes for a joke we would put him inside of a large trumpet-flower or in a lamp-chimney or tumbler, and he seemed rather to enjoy his imprisonment. When left to his own resources he ran about the house, sunned himself in a neighboring tree, or

caught flies by approaching them very slowly and grabbing them with one hand. If long neglected he became aggrieved; then he would find some conspicuous perch and give vent to his troubles in a series of shrill screams. If still unnoticed he would scream yet louder, his face expressing, as only a marmoset's can, the depth of his feelings; the hair on his forehead standing on end, and his whole body trembling with rage. But the exceeding force of his vocal powers was only displayed when we punished him, or when—rare and dreadful occurrence—he was washed; then indeed his lamentations became shrieks and every line of his face evinced his abhorrence and wrath. On such occasions Billy could only be appeased with a comb; for to be combed was his idea of perfect happiness. As soon as he felt the delightful touch all sounds would cease; with eyes fixed on vacancy and face expressive of speechless bliss, he would stretch out all four arms and lie quite still as long as we pleased to comb him. He would then submit to lie on his back while his breast was combed, or he would cling with his two front hands to a friendly finger, and with two hinder hands to a chair, while his body was stretched to its utmost length; he would even hang by his hinder hands with his head down, or let us hold him up by the tail.

Billy, having never known a wild life, cared nothing for liberty; if lost in the forest, as happened once or twice, he soon brought us to him by his screams. He slept in a little basket, but generally broke out before morning and climbed to my wife's bed, nesting on her shoulder. Sometimes we carried him in the basket while on our journeys, and he was always well contented so long as he felt that he was moving; but if we laid the basket down he presently broke into his usual heart-rending jeremiad. Our first attempt to carry him on horseback resulted well until Billy noticed the horse; then a scream of terror was followed by a wild rush for some hiding place, and he eventually took refuge in the top of one of my great riding-boots. He was intensely afraid of cats and dogs, but cared nothing about birds, turtles or snakes. We had a tame land-tortoise which sometimes shared Billy's basket and the tortoise was frequently robbed of his dinner by its room mate, who would sit on its back and cooly devour the spoil. The monkey ate almost any vegetable, and even a little meat; he was especially fond of almonds and of cheese, both of which generally resulted in indigestion. He also had an

undue fondness for tragacanth paste, which we sometimes used in our work, and if we covered the paste cup he would spend hours trying to pry the cover off. Being spoiled, he was rather saucy, considering that he had the first right to every dish on our table, and helping himself without ceremony, especially to the sugar and milk; brandy he would take if it was well sweetened. Once or twice, while we were living at a hotel, Billy broke loose at dinner time and astonished the boarders by racing over the table to my wife's chair, ending by sitting on her shoulder and making one of his inimitable faces at the assembled people. One day when he occupied his usual place near us a nicely ornamented boar's head was brought in with grinning jaws and staring eyes made of lemons and olives; the monkey, who had never seen the like, put out both hands as if toward the apparition and retreated with a yell to the farthest corner of the room, whence he was taken trembling.

When we first brought him home Billy's curiosity was much excited by the looking-glass in which he saw, as he supposed, another monkey; having tried in vain to reach his playmate from the front, he looked around the glass and was evidently disappointed at finding nothing there; this performance was repeated at intervals for some days, but after awhile he became accustomed to the phenomenon and did not notice it further. He was fond of bright colors, gilt buttons, glass beads and the like; often he tried to pick the flowers from my wife's muslin dress; grasshoppers and beetles were a treat to him, though he seemed to care more about tearing them to bits than eating them; he learned after repeated punishments that he must not touch our collections, though he sometimes stole a specimen on the sly.

As the cold weather came on Billy grew sickly, keeping much to the shelter of his basket. One morning he woke in strong convulsions, which were followed by others in quick succession. Coming out of the last he lay quiet for a moment and we had hopes of saving him; but, as my wife extended her hand to him, he stood up with an effort, made one of his drollest faces at her, and fell over dead. I suppose that there was not a dry eye in the house when we buried him—my wife had resented as sacrilege the idea of saving his skin for a specimen—and we all agreed that no more playful and affectionate pet had ever been seen. Weeks afterwards I found my wife furtively placing flowers on his grave.[1]

[1] I have tried to describe the marmoset's habits accurately and literally, and no part of the account is exaggerated.

ON THE EVIDENCE THAT THE EARTH'S INTERIOR IS SOLID.

BY DR. M. E. WADSWORTH.

IT is well known that the facts of geology require some mode of escape from the now generally-received opinion that this earth is a solid globe. This is especially shown by the introduction of so many hypotheses to avoid the logical consequences incident upon such a globe. Some of these hypotheses are lakes of still unsolidified material; masses of readily fusible materials; aqueo-igneous solution of sediments; fusion of the earth's interior on the removal of pressure; a solid crust and a solid core with a zone of liquid matter between, etc., etc. All these views are simply compromises between the known fact that some part of the earth must be liquid in order to account for geological phenomena and the supposed physical and mathematical demonstrations of the earth's solidity. These compromises are unnecessary if it can be shown that the claims for the earth's solidity are not well based.

The facts of petrography likewise seem to the writer to demand the belief that all eruptive rocks have come from the earth's interior, below any of the sedimentary deposits. Also that they must have come from material that has either never been solidified or else has been reliquified.

This paper has arisen out of the fact that to the writer's mind there appeared a diversity between the commonly taught hypothesis of the earth's structure and observed petrographical facts. He therefore undertook an examination of the principal published data in order to see whether the error resided in the petrographical observations or in the data for the hypothesis of a solid earth. The result led to the writing of this paper nearly two years ago, and it now stands essentially unchanged. Its object is to place before others the chief lines of argument in behalf of a solid earth and to indicate that geology and petrography have as yet the right to assume any structure for the earth's interior consistent with known facts, without regard to the so-called physical and mathematical demonstrations of its solidity.[1]

The Evidence of the Earth's Solidity derived from Precession and Nutation, and the Tides.—The most prominent of the early advo-

[1] *Science*, 1883, I, 127–150.

cates of the essential solidity of the earth, was Mr. William Hopkins, who based his conclusion upon the phenomena of precession and nutation. In order to mathematically investigate this question, he made two assumptions regarding the earth: 1. That it was composed of a homogeneous fluid mass contained in a homogeneous solid shell. 2. A heterogeneous fluid inclosed in a heterogeneous solid shell. In both cases the transition was assumed to be "immediate between the entire solidity of the shell to the perfect fluidity of the interior mass." He further assumed that the circulation would go on in every portion of the mass until it had lost its perfect fluidity throughout the entire mass at nearly the same instant. This of course could only be correct if the liquid was homogeneous. He did, however, state that a viscid condition of the liquid would prevent the descent of the cooled exterior portions towards the interior. With a globe constituted as above for his basis, Hopkins concluded that the phenomena of precession and nutation did not demand on the earth a crust of over 1000 miles in thickness, but they did require one at least 800 miles thick. In order to account for volcanic phenomena, he assumed that there were in the solidified crust, lakes of molten material whose origin was to be ascribed to a greater fusibility of the material composing them, than of that forming the surrounding solid crust.[1]

Professor Hennessy later held[2] that in a fluid globe the denser particles would sink through the lighter, while the lighter ones would ascend through the heavier, until an equilibrium of the mass would be reached, so that the globe "would consist of a series of spheroidal strata, each of uniform density throughout its own mass." He further remarked: "The exterior portions of the fluid would cool first, until they would acquire, according to the particular circumstances which may influence their cooling, certain densities. If the effect of refrigeration be in general an increase in density of the matter cooled, then the cooled portions of the fluid will sink. The higher temperature of the matter yet unexposed to cooling influence would then tend to change the acquired densities of the cooled matter. The as yet uncooled fluid would have its temperature reduced from contact with the cold particles from above, and it would tend to change its pos-

[1] Philos. Trans., 1839, pp. 381–423; 1840, pp. 193–208; 1842, pp. 43–55.

[2] Philos. Trans., 1851, pp. 495–547.

tion in a similar manner to the portions first cooled. As each cooled portion of the fluid descends, the three following causes would therefore impede its descent:

1st. From the arrangement already indicated of the denser strata about the center of the mass, and from the nature of the law of density of the strata, each stratum into which the cooled fluid would descend, would be denser than the preceding.

2d. If the general effect of the refrigeration be to increase the density of the cooled matter, each stratum would have its density augmented by the passage through it of the cooler matter from above.

3d. The descending portions will have their densities diminished by the increase in their temperature.

With an earth thus constituted for his starting point, Hennessy concluded that its crust could not be less than eighteen miles thick nor more than 600 miles. He further claimed that owing to friction, viscidity, and pressure it was probable that the fluid interior and the solid exterior would rotate nearly as if the earth was solid from its center, thus denying the validity of Hopkins' conclusions.

Professor Samuel Haughton, starting from the assumed premise that the earth was "composed of a solid shell, having the density of the rocks at the surface and a fluid homogeneous nucleus," also having a fluid heterogeneous one, deduced 768 miles as the probable thickness in both cases.[1]

The conclusions of Hopkins were sustained by Sir William Thomson. He starts with the hypothesis that the earth is composed of a thin shell which passes abruptly into a homogeneous incompressible fluid, mobile like water, which forms the interior. He also assumes that this liquid interior is heterogeneous and viscid. Taking for his starting points globes such as these, he concludes that the earth is more rigid than a homogeneous globe of glass and probably than one of steel.

Thomson further claimed that it was demonstrable that the earth solidified from the center, because melted rock contracted on solidifying, and that hence the crust would sink to the center as soon as formed.[2]

[1] Trans. Roy. Irish Academy, 1851, XXII, 251–273.

[2] Trans. Roy. Soc. Edin., 1864, XXIII, 157–169; Phil. Mag., 1863 (4), XXV, 1–14, 149–151; Phil. Trans., 1863, pp. 573–582; Thomson and Tait's Natural Philosophy, 1867, I, 670–727; Trans. Geol. Soc. Glas., 1878, VI, 38–49.

Thomson's views were republished and reaffirmed in 1872,[1] but in 1876 he says, regarding his previous argument from precession and nutation, as the result of a conversation between himself and Professor Newcomb: "Trying to recollect what I had written on it fourteen years ago * * * my conscience smote me, and I could only stammer out that I had convinced myself that so-and-so and so-and-so, at which I had arrived by a non-mathematical short cut, were true. He hinted that viscosity might suffice to render precession and nutation the same as if the earth were rigid, and so vitiate the argument for rigidity. This I could not for a moment admit, any more than when it was first put forward by Delaunay.[2] But doubt entered my mind regarding the so-and-so and so-and-so, and I had not completed the night journey to Philadelphia, which hurried me away from our unfinished discussion, before I had convinced myself that they were grievously wrong."[3]

Thomson, however, strongly affirmed the correctness of his views regarding the rigidity of the earth as determined by the phenomena of the tides. It is permitted, since he still retains his view that the crust when formed would sink, from its weight, to the center, to think that if he would affirm the precession and nutation theory, for fourteen years, so often as he had, without giving it sufficient thought, that possibly with the very imperfect tidal data at his command, he has not looked at this question in all its bearings.

Professor Hennessy indeed in 1872 pointed out that Thomson had assumed a spheroidal homogeneous elastic shell filled with incompressible fluid, and that all the latter could claim to have proved was, "that the earth does not consist of an elastic solid envelope enclosing a mass of the ideal substance called an incompressible liquid." Hennessy also justly calls attention to the fact that Thomson's method of proving the rigidity of the earth by assuming, first, that it is a homogeneous mass of glass, and again of steel, is an argument of the same kind, as if one should attempt to prove that rapid locomotion in railway trains was impossible, on account of the shocks the passengers would

[1] *Nature*, 1872, v, 223–224, 257–259.

[2] This is an error of Thomson's, since Hennessy advanced this view in 1851, seventeen years before Delaunay. See *Nature*, 1871, III, 420; *Geol. Mag.*, 1871 (1), VIII, 216–218.

[3] Report Brit. Assoc., 1876, XLVI (Sect.), 1–12.

be subject to, by assuming as his premise that the carriages were rigidly attached to one another.[1]

Delaunay further objected to the precession and nutation theory of Hopkins and Thomson, on account of the slowness of the motion and the viscidity of the liquid interior, which would cause the earth to act as if it were a solid body.[2]

From observations made on the deflection of the plumb-line by the Himalaya mountains, Sir George B. Airy held, "that the whole of that country is floating upon a dense fluid, and that the thick mass of the lighter mountain-matter sinks deep in the fluid, and that the displacement of denser matter neutralizes almost entirely the attraction of the lofty mountains. The form of the earth is not such as would be taken by a solid structure, but such as would be taken by a fluid mass with solids floating upon it."[3]

In the case of Mr. Geo. H. Darwin's papers, it is difficult in some cases to understand exactly what he regards as the constitution of his assumed mathematical globes, and to express his ideas in non-mathematical language. His investigations appear to be made on the suppositions that the globe is a viscous non-elastic spheroid, an elastico-viscous one, and one either elastic, plastic or viscous. All these, if he is rightly understood, are considered to be homogeneous. Darwin then states that the chief practical result of this paper may be summed up by saying that it is "strongly confirmatory of the view that the earth has a very great effective rigidity," the term earth being substituted for the hypothetical globes mathematically investigated by him."[4]

In one paper he says that the word earth is used as an abbreviation for "a homogeneous rotating viscous spheroid."

In a later paper "On the stresses due to the weight of continents," he assumes that the earth is a homogeneous elastic sphere, of which two conditions are possible, one that it is incompressible, the other that it is compressible. He then proceeds to show that in an earth thus constituted a state of stress must exist, owing to the inequalities between the continents and sea floors. From the discussion of this supposed condition, he says: "It appears that if the earth be solid throughout, then at a thousand miles from the surface the material must be as strong as

[1] *Nature*, 1872, v, 288, 289.
[2] *Geol. Mag.*, 1868 (I), v, 507–511.
[3] *Nature*, 1878, xviii, 41–44.
[4] Philos. Trans., 1880, clxx, 1–35, 147–593.

granite. If it be fluid or gaseous inside, and the crust a thousand miles thick, that crust must be stronger than granite, and if only two or three hundred miles in thickness much stronger than granite. This conclusion is obviously strongly confirmatory of Sir William Thomson's view that the earth is solid throughout."[1]

This statement of Professor Darwin seems to me misleading, for if his paper is understood aright, he has proved nothing of the *actual earth*, but only of a *hypothetical homogeneous elastic incompressible or compressible globe*, and for this assumed globe he has substituted the term *earth*, the same as the algebraist uses the terms x and y.

Is there a single geologist who believes that it is possible for this earth to have any such structure as that assumed for it by Thomson, Darwin and others? The difficulties placed by the physicists in the way of a belief in the earth's liquid interior, seem to be of their own making. These difficulties arise from the assumptions and limitations that the physicists have to impose upon the problem to bring it within the range of mathematical analysis. They have taken premises that no geologist would take, and having proved their point regarding these assumed premises, then claimed that they have proved it for this *earth*. What physicist has taken as his basis the most probable condition of the earth if its interior is liquid; a heterogeneous, viscid, elastic, liquid interior, irregularly inter-locked with and gradually passing into a lighter heterogeneous crust? The problem is believed to be beyond the power of any transcendental mathematics now known, and it is not believed to be possible mathematically to prove, at present, anything regarding the actual state of the earth's interior.

Our conclusions as to that state appear to be dependent on the evidence that can be derived from geological and petrographical studies. Professor Hennessy appears to have taken, as the basis for his mathematical discussion, data that are nearer the probable constitution of the earth than those assumed by any one else, and his results are entirely consonant with the hypothesis of a fluid interior.

It is as necessary that physical and mathematical discussions of the state of the earth's interior should conform to geological facts, as it is that geological theories should conform to physical and

[1] Philos. Trans., 1882, CLXXII, 187-230.

mathematical laws. It is incumbent on the physicist to explain earthquake motion, the sinking and rising of different portions of the earth's crust, volcanic phenomena, the uniformity in composition of lavas, the structure of volcanic rocks, sedimentation, faulting, vein formation, etc., etc., by his theory of a solid globe. Geological *facts* are just as positive as physical ones, and it is as necessary for the physicist to reconstruct his theory of a solid earth to suit geological facts, as it is for geologists to reconstruct their theories to suit the so-called physical demonstrations of a solid earth—demonstrations that merely show that under the assumed conditions and hypotheses the physicist's imaginary globe must be a solid one.

Are not speculations, speculations still, even if threaded together by a long series of mathematical formulæ, and are not all so-called mathematical proofs of the earth's solidity the mere working out of certain assumptions? Huxley was indeed right when he said, as the present writer would like to say: "I do not presume to throw the slightest doubt upon the accuracy of any of the calculations made by such distinguished mathematicians as those who have made the suggestions I have cited, * * * but I desire to point out that this seems to be one of the many cases in which the admitted accuracy of mathematical processes is allowed to throw a wholly inadmissible appearance of authority over the results obtained by them. Mathematics may be compared to a mill of exquisite workmanship, which grinds you stuff of any degree of fineness; but, nevertheless, what you get depends on what you put in; and as the grandest mill in the world will not extract wheat-flour from peascods, so pages of formulæ will not get a definite result out of loose data."[1]

Not only in mathematical and physical science, but in all science, no amount of discussion can give the conclusion any greater strength than the premises have, but attracted by the conclusion or by the chain of argument, the data are apt to be overlooked. Were this not the case many a structure, reared with great care and now regarded as established, would be found to rest on flimsy foundations.

So far then as the mathematical and astronomical determinations of the earth's solidity are concerned, it would seem that great doubt exists as to the correctness of the premises as applied to the earth, and hence like doubt regarding the conclusions.

[1] Presidential address. Geol. Soc. London, 1869, p. l.

When calculations shall be based upon the best data obtainable as to the materials of the earth's interior and their arrangement therein, then, and not till then, will mathematical calculations have real weight that geologists are bound to respect, but that day is a far distant one.

In the mathematical discussion of the state of the earth's interior, it has been customary to select a homogeneous globe of uniform density, but when the earth has been assumed to be heterogeneous and of varying density, it has been regarded as composed of layers, the layers being of unequal density when compared with one another, but of equal density throughout their own mass.

The more probable condition is that of a globe with a gradual increasing density from the exterior towards the interior, but with the materials heterogeneously arranged in the so-called layers. While the heavier materials would increase in abundance and the lighter diminish as the interior was approached, and *vice versa*, these materials at any one point would be found to be mixed together in varying proportions, the same as they are in meteorites and terrestrial eruptive rocks. While the extremes of the series may, indeed, be free from one another's components, the intermediate layers would contain more or less of the materials that predominate in the other portions of the earth's interior.

(To be continued.)

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VESTIGES OF GLACIAL MAN IN MINNESOTA.

BY MISS FRANC E. BABBITT.

DURING the open winter of 1878–9 and the seasons immediately succeeding it, the writer of this paper chanced to be engaged in searching certain terrace surfaces of the Mississippi river for palæolithic remains supposed to exist at the locality under examination. Rudely worked quartzes had previously been discovered here by the State geologist of Minnesota, Professor N. H. Winchell, by whom they had subsequently been described and figured in the State geological report for 1878. The field of exploration lies in central Minnesota, about one hundred miles northwest of St. Paul, and within the township and small village of Little Falls, Morrison county. Its area is at present restricted

to a narrow section of the Mississippi valley, stretching along the river a short distance from the central site of observation.

The find reported by Professor Winchell consists of chipped objects of a class generally ascribed to what is called the *rude stone age*. Of these, many appear to be mere refuse, while others are regarded as finished, and unfinished implements. The Winchell specimens have been assigned, upon geological grounds, to a prehistoric era altogether antedating that of the mound-building races, and reaching back to a time when the drift material of the terrace-plain was just receiving its final superficial deposit. It is found that, at intervals, the surface soil of the terrace is permeated with these quartzes to a depth of not unfrequently three or four feet.

The lowest and newest formation at this place constitutes the actual flood-plain of the river. It is still in process of development, is of fluctuating width and thickness, and is, at certain points, yet subject to partial overflow at periods of exceptionally high water. In that portion of the township of Little Falls situated east of the Mississippi, this bottom land is limited on the east by a higher ancient river terrace, which has, at the head of the rapid called Little Falls, an average elevation above the river of about twenty-five feet, with a width of a mile or more.

This older terrace, like the present flood-plain, is of undoubted *drift* origin, and has been spread out by the immediate action of water. Mr. Warren Upham, assistant on the State geological survey, tells us that it consists of stratified gravel and sand; that it forms a part of the modified drift, deposited at the close of the last glacial epoch of the great ice age, by the floods descending along this valley from the melting and retreating ice-sheet; and that it was derived from the drift material which had been contained in the lower portion of the ice. It belongs to the great system of river-terraces, extending from an indefinite beginning on the north, to the embouchure of the Mississippi on the south. Wherever from any cause the lower plain, or bottom-land, does not exist, the edge of the upper plain becomes, of course, the real bank of the river; at places where, on the other hand, the newer deposits appear in force, the ancient terrace-banks either abut directly upon them in a pronounced line of steeps, or descend to them by gentle slopes.

The upper terrace of the Mississippi valley is, at Little Falls,

defined on the east by a broken chain of uplands which take on different names in different parts of their course. Thus they are known in Wisconsin as the *Kettle range*, and in Minnesota and Dakota, as the *Coteau des Prairies* and the *Coteau du Missouri*, respectively. Geological authorities agree that the range indicated is a series of terminal moraines, and that it defines the limits attained by the great northern glaciers, at the acme of their southern advance, during the last of the universally recognized glacial epochs of North America. The morainic belt is regarded as an accumulation of débris, due to long-continued glacial halts, and alternations of advance and recession; the rubbish thrown down by ice melting while stationary or creeping back, at one time, having been plowed up and redistributed at the next subsequent period of forward movement. When the climate at length became permanently warmer, and the glaciers withdrew for the last time to the frozen regions of the north, they left their outline traced, as in a scroll of huge hieroglyphics, across the open page of the continent.

This morainic belt does not follow the lines of latitude, but descends to its southern limit in an irregular series of broad and often very long lobes. These touch each other, and merge into one at their lateral borders, on the east and west, while at the southern terminus each preserves an independent outline, taking on a rounded contour at the extremity, and ending in a more or less elongated curve prolonged towards the south. Thus we have, in southern Wisconsin, the well defined moraine of a great glacier descending from Lake Michigan into northern Illinois, the western edge of which was joined by the eastern margin of a similar ice-current coming down from Green bay. The débris of their united edges moved forward along the midst of their combined masses in a single line of aggregation, now known as a *medial moraine*. At the extremity, each glacier descended independently to the south, where the moraines of both yet exist in the form of two large, irregularly rounded lobes, joined at the base of the medial moraine.

Still west of the Green Bay moraine lies that of the northeast glacier, the western edge of which is skirted, at Little Falls, by the terrace-plain of the Mississippi river, as hitherto described. A few miles further west still, on the opposite side of the Mississippi, yet another moraine of the modern epoch comes down from

the northwest, but without impinging directly upon that from the direction of Lake Superior in the latitude of Little Falls, where the two are separated by an interval of several miles. As we are assured, however, by Mr. Warren Upham, the two finally come together in Stearns county, some little distance south of Morrison county. Geologically considered, then, the field of study lies in an ancient terrace-plain east of the Mississippi river, is situated precisely between the northeast and northwest moraines, and is, so far as the quartz stratum to be described is concerned, buried under an accumulation of modified drift deposited by glacial waters.

While occupied in examining the river bank in quest of wrought quartzes, one day during the season of 1879, I had occasion to ascend a slope lying between the new flood-plain and the older one, by a pathway leading through a sort of gap, or notch, in the latter. Henceforth I shall, for the purpose of more emphatic distinction, denominate the lower and higher levels under consideration as *bottom-land* and *terrace-plain*, respectively. It seemed that at some past period a cut had been effected here by drainage, and that the washout thus formed had afterward been deepened through being used as a wagon-track. In this notch I discovered the soil to be thickly strewn with pieces of sharp, opaque quartz. These were commonly of a white color, and ranged in size from minute fragments to bits as large as a man's hand, and in some instances even larger.

There were many hundreds of these chips visible, scattered over an area of the width of the wagon-track, and ten to fifteen yards in length. They were conspicuously unwaterworn and likewise, in the main, unweathered, though occasionally a bit was picked up having some one of its surfaces weathered, while fractured or wrought faces appearing upon other parts of it, looked as fresh as if the work of yesterday. On the other hand, the mass of stone rubbish upon and among which the quartzes were strewn, is much waterworn, many of the pieces being well rounded, while none of them are wholly angular.

Most of these quartz pieces had, when first observed, a sort of bleached exterior unlike that of the rusty-looking specimens subsequently exhumed from the stratum adjacent; but this was no doubt due to the complete superficial cleansing to which they had been subjected by recent exposure to the elements. At all events,

the bleached appearance proved a merely temporary characteristic, for although the quartzes received a thorough washing up immediately after being collected, they directly began to take on anew a tawny yellowish tint which, within a few months, became decidedly pronounced. They were again carefully cleansed with brush and water, again to resume their rusty tone of color. In a few instances the process of brushing clean was repeated at intervals of four or five months, a third and even a fourth time, with similar results. The degree of discoloration appears to vary with the quality of the specimens affected, the most compact varieties of mineral undergoing the least modification of tint. The coloring also fluctuates, probably, with the fluctuating proportion of iron in the containing soil.

It was soon ascertained that the notch, and the surfaces immediately surrounding it, afford no boulders nor other supplies of quartz except these chips. Nor does quartz appear on the east shore within a radius of perhaps an eighth of a mile from the spot, although it occurs plentifully just north and south of these limits, both in the form of veins in the slate rock of the region, and in that of waterworn river-wash and occasional boulders. Waterworn lumps of quartz are now and then found, it is true, in the subjacent till, but the latter lies several feet lower than the quartz-bearing stratum, beneath which it directly penetrates, and hence could never have yielded the specified objects through natural processes. An additional fact, worthy of note, is the invariably small size of the pieces disclosed. But a single fragment larger than a club-head has, as yet, come to light anywhere at the notch, and that one was not imbedded in the undisturbed strata at the notch proper, but in the débris at its base and west of it. Even could there have existed at this site masses of mineral important enough to furnish the tens of thousands of chips and lumps with which the place has proved to be paved, it appears wholly incredible that such rocky masses could have been thus absolutely annihilated, except through human interference. The waterworn stone rubbish below the quartzes remain undisintegrated, therefore so we should expect the latter likewise to be found. There is no known reason why, having been subject to the same influences, the one should have been broken into small pieces, and even splintered into the tiniest bits, while the other escaped disintegrating forces.

In view of the circumstances cited, it was finally concluded that the quartzes must have been artificially transported to their actual position, perhaps in fragments, perhaps in masses which were afterward broken into fragments. For a period of about four years the quartzes were largely augmented in number at every succeeding freshet, during which they were washed out of the inhuming sand of the roadway by descending drainage. Their immense and continually increasing quantity finally seemed to warrant the belief that they had resulted from systematic operations of some sort, once conducted, for unknown purposes, upon that particular spot. A portion of the studied specimens subsequently yielded evidence of having received shape from human hands.

The theory of neolithic origin was, from the beginning, beset with embarrassments. Certain incongruous developments became increasingly perplexing with the advance of investigation. The spot appeared to be peculiarly unfitted by nature for a base of quartz-working operations. It was unintelligible, for example, why an important industry of this sort should have been established at so great a distance from quartz boulders and quartz-bearing rock, especially as convenient plains occur about the nearest exposures of this mineral. Again, why should such a manufactory have been set up upon a steep hill-side with its approaches of such a character that all the material to be handled, as also the implements fashioned, would have to be transported to and fro, up and down a considerable acclivity? Above all, why should this workshop have been relegated to the bottom of a natural drain, the solid contents of which were necessarily overwhelmed, or swept away bodily, at every considerable rainfall and thaw of the year? As an illustration of the superficial disturbance to which the place was subject, I may mention that at the close of a long but by no means exceptionally protracted rain-storm, I once collected from the notch, by actual count, about one thousand quartzes, all newly plowed out of the soil at that one time. Of this I was certain, as I had previously cleared the ground of every quartz piece of any size within view.

A final fact wholly irreconcilable with the hypothesis of neolithic origin, was the absence of quartzes from the surfaces at the superior edges of the notch, and along the terrace-plain adjoining. It was

not for a moment to be believed that such remains would have been thus distributed by aboriginal artificers. It was simply impossible that the quartz-workers should have limited their manipulations to a strip of sand six or eight feet wide and thirty to forty long, less or more, heaping upon this narrow defile thousands upon thousands of fragments, yet leaving absolutely no small splinters nor chips beyond, neither up the slopes of the notch nor elsewhere in the vicinity.

The above-cited peculiarities of distribution remained the puzzle of the situation until certain of the accumulated objects began to range themselves under types which, though vaguely outlined in touches of extremely rude workmanship, were, nevertheless, distinctly palæolithic in general tone.

The quartzes were now, for the first time, conjecturally classified with the palæolithic implements discovered by Professor Winchell imbedded within the surface of the terrace-plain, and figured in his geological report of a reconnoissance in Morrison county. It was judged that, as had been the case with the Winchell specimens, these objects had been included, primarily, within an upper stratum of the terrace-plain, whence they might easily have been washed by the drainage water copiously discharged through the notch. Such pieces, it was argued, would naturally be stranded near their starting point, yet at a level somewhat below, while the finer enveloping sand associated with them would be carried on and deposited at a more distant spot. It is necessary to keep in view the distinction between *post-glacial* relics and the quartzes found by Professor Winchell. The discoverer holds these latter objects to be essentially a part of the drift of the last glacial epoch, and considers them to have been fashioned prior to the spreading out of the uppermost material of the plain in which they are, at various points, distributed. It goes without saying, that post-glacial remains, on the contrary, are or have been posed upon the face of the drift, and not within its mass. In searching the spot for Indian relics I had confined my attention principally to the surface of the ground; in setting up a quest for palæolithic objects of the class described by Professor Winchell, I examined vertical sections of the upper terrace-plain to a depth of several feet.

Prolonged investigation ensued, establishing the hitherto unsuspected fact that the notch quartzes could never have been

directly involved in the terrace surfaces. Had they once been thus inhumed, the superficial stratum of adjacent drift would assuredly have been found to contain a greater or less proportion of similar fragments, scattered throughout its substance. But this was not the case. On the contrary, no buried quartzes whatever appeared in the superior exposures of the notch, nor within the horizontal surfaces at either hand, though such were sought with careful scrutiny. Since November, 1879, at which time the studies here recorded were in active progress, the wagon-track hitherto mentioned in this paper has been converted to public use as a highway, and has been repeatedly graded in consequence. As might be conjectured, the ground has been much dug over, the stratum being, at present, almost broken up and destroyed, if not wholly so. During three successive seasons, the road has been in a state of almost constant repair, owing to its being continually used for the heavy work of dragging logs from the bottom-land to the top of the terrace-plain. From this and other disturbing causes, not necessary here to specialize, the topography of the spot has been materially modified of late, while quartzes from the bed of the notch, as likewise from the stratum at first discovered, have been much mixed up with the surrounding soil. Primarily, however, as I permit myself to reiterate in the way of emphasis, I could not, with a great deal of painstaking, find any superficially inhumed quartz fragments at the point of observation; although, as shown by Professor Winchell, and as I have myself had abundant occasion to observe, such quartzes occur in the surface stratum of the terrace-plain at various isolated localities in the vicinity. So far as I have been able to judge, these appear in groups which are surrounded by considerable areas containing no observable remains. The absence of chips above a plane a foot or two superior to that of their bed at the bottom of the notch was, of course, a marked circumstance, since they should have occurred plentifully in the superficial stratum, had the notch chips been, as assumed, of the same age with Professor Winchell's find.

Ultimately it was ascertained that the notch quartzes had dropped to the level at which they were first seen, from a thin layer of them, once lying from ten inches to two feet above, and subsequently broken up through the eating out of the sand underneath by drainage, supplemented by the action of wagon-

wheels. This layer or stratum was still intact on the north and south, and partially so on the east, in which direction it had, however, at certain points suffered displacement by wagoning. It extended in what at the time appeared to be a nearly horizontal plane, into the terrace, in the sloping edge of which the notch, opening in the west bank of the terrace and truncated at its edge, is cut. Its outlines, lying within the walls of the notch, were masked against ordinary observation by thin slides of soil from higher surfaces. Both the inferior and superior planes of the quartz bearing stratum were sharply defined. Its horizontal boundaries had not been distinctly reached in any direction at the time of excavating for the road, and they have since been, at least partially, and perhaps wholly, obliterated by the grading and digging over to which the spot has been subjected. At the west the stratum reached to the limit of the terrace, which is here bounded by a steep slope. The quartz-bearing layer averaged a few inches only in thickness, varying a little as the included pieces happened to be of smaller or larger size. The contents were commonly closely compacted, so much so that one might sometimes extract hundreds of fragments, many of them very small ones, of course, from an area of considerably less than a square yard.

The quartz bed, as far as examined, rested upon a few inches of sandy soil which passed downward into a coarse stone rubbish immediately overlying till. Upon the quartzes again, were superimposed drift accumulations extending up to the surface of the terrace. These were characterized, by geological authority, as sand above and sand and gravel below. The pebbles of this gravel were small and well rounded, and were noticeably less angular than those of the rubbish beneath. The stratum of quartzes lay at a level twelve or fifteen feet lower than the plane of the terrace top. The exposed deposit has been found to dip toward the west, and apparently also toward the south; but these inclinations, particularly the former, may be partially or wholly due to the giving way of underlying rubbish. At an early stage of investigation the soil above the quartzes presented to the eye no contrast in color with that of the soil below them. After penetrating some little distance, in a horizontal direction, into the terrace, however, the superior and inferior strata began to show a plain divergence in point of tint, the lower one taking on a dull

yellowish red tinge. After a certain degree of exposure the differential color line fades out, perhaps through the washing into the edges of the excavation of foreign material. Still it has been found to be set up anew at every fresh cutting.

At present everything indicates that these Little Falls quartzes were originally posed upon an ancient surface, since covered by what the glacialists term *modified drift*, now forming all the upper part of the terrace-plain. It will be remembered that the quartz chips and implements discovered by Professor Winchell, in this vicinity, are contained only in the upper stratum of the terrace-plain. Now the notch quartzes do not at all appear at the terrace top, and cannot have been derived from it. They are, on the other hand, confined strictly to a single thin stratum of the lower gravels closely overlying till, and sometimes, perhaps, merging into it on the west, as hereafter explained. Hence the two sets of objects cannot be synchronals, though they may have been produced by the same race at different stages of its existence. The notch quartzes must of course be older than those of the superior stratum of drift by at least the lapse of time required for forming and draining the deposit lying between the quartzes below and those above.

Professor Chamberlin, State geologist of Wisconsin, in treating of the ancient vegetal deposits of his district, precisely indicates what at the present moment appears to be the glacial position of the Little Falls quartz stratum. Speaking of the Kettle moraine of Wisconsin, which is continuous with the northeast moraine of this region, he says:

"Some of these organic strata lie at the immediate foot of the moraine beneath fluviatile and lacustrine deposits that, I am confident, began to be accumulated during the accumulation of the moraine and through the agency of glacial floods."

The observations recorded above are offered in their present form as a special answer to inquiries and suggestions propounded to the writer, from time to time, by archæological investigators. They are likewise adduced as evidence that the theory of an ancient quartz-paved surface is not the result of a mere hasty guess, but is, on the contrary, the slow outgrowth of many particular observations and deductions. Certain of these, however, remain yet to be stated. The facts above given will, it is hoped, plainly illustrate the successive steps by which the present

working hypothesis has been reached. They are arranged to show:

First; why the notch quartzes are not attributed to natural causes now operating upon the present surface.

Second; why these objects are not ascribed to modern races once inhabiting the region.

Third; why they are not classed with the implements previously unearthed at Little Falls by Professor Winchell.

Fourth; why they are referred to a palæolithic people once inhabiting an ancient till surface, which is at present buried beneath a sheet of modified drift. Of this, however, more hereafter.

At present, palæolithic remains are assigned to three distinct eras:

The *preglacial*, or anteglacial, including geological time wholly preceding the ice epochs.

The *interglacial*, time between any two of these epochs.

The *intraglacial*, time during such an epoch.

According to the generalization of Geikie, adopted in this paper, *postglacial* relics, however rude they may be, are not truly palæolithic, although they may be popularly reckoned as such.

It is not possible that the notch quartzes belong to the first of these palæolithic classes. They cannot be preglacial because they are based upon till, a deposit which is universally acceded to be a ground moraine, formed, in some way, at the bottom of a glacier, and left behind when the glacier withdraws. In the present case the underlying till must not only have been laid down, but must likewise have been permanently uncovered by the recession of the producing ice, before the quartz-workers could at all have gained access to it, much less have set up their primitive industries upon its surface. These objects are furthermore clearly not postglacial, because they lie under a sheet of modified drift, fifteen feet and less in thickness, which has certainly been produced in one way or another by dissolving glaciers.

The question whether the quartz deposit is intraglacial or interglacial in origin is one which is not so readily answered in the present state of our knowledge. Indeed, it may very well be both perhaps; that is, it may have had a beginning prior to the final advance of the northeast and northwest glaciers, and then have continued to exist, and to receive accretions from time to time, up to a period during the second ice age when these glaciers

were in process of final liquefaction. Certain elements of the geological situation recently developed by American scientists, and already touched upon in this paper, necessarily enter as essential factors into the solution of the problem before us. The following is a summarized recapitulation of glacial principles enunciated by authorities now engaged in deciphering the ice chronicles of the Northwest:

That this whole region has been subjected to a period or periods of glaciation antedating the last.

That a longer or shorter era of deglaciation, known to scientists as an interglacial epoch, intervened between the deposit of the older tills and the readvance of the northeast and northwest glaciers during the latest ice period.

That the general direction of glaciation was similar during the earlier and later ice epochs, though it was not always precisely the same.

That glaciation was far more extended in its range at the former of these periods than at the latter; the ice of the former having stretched fully three hundred miles south of the termini of the modern morainic lobes.

That the modern morainic belt defines the limit of extension of the glaciers during the last ice epoch.

Finally, that the Little Falls quartz stratum lies between the modern moraines of the northeast and northwest glaciers, in a medial morainic belt which is characterized by a system of overlapping tills, as described in Mr. Upham's paper at the close of this article.

The above elements sum up the glacial situation as understood by specialists, so far as concerns the quartz stratum under consideration. The tills of Morrison county have, up to the present time, not been fully reported upon, and their special interrelations are accordingly very imperfectly understood.

(To be continued.)

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THE GENESIS OF CRYSTALLINE ROCKS.[1]

BY T. STERRY HUNT, LL.D., F.R.S.

THE writer began by an account of the various hypotheses hitherto proposed to explain the origin of the ancient crystalline stratified rocks, of which gneiss may be taken as the type,

[1] Abstract of a paper read before The National Academy of Sciences, April 15, 1884.

(1.) The *plutonic* hypothesis, which conceives the rocks in question to have been formed by the superficial cooling of a molten globe before the precipitation of water upon its surface. (2.) The *volcanic* hypothesis, which supposes them to be derived from igneous rocks, like lavas, coming from a liquid interior through the primitive crust. (3.) The detrital or *clastic* hypothesis which conceives them to have been made of the ruins of plutonic or volcanic rocks, more or less disintegrated or decayed, rearranged by water, and subsequently modified by chemical changes. Similar alterations, through subsequent action of water, are also invoked by the advocates of the plutonic and volcanic hypotheses. (4.) The *chaotic* hypothesis, which supposes the elements of all these rocks to have been at one time dissolved or suspended in the water of a primitive chaotic ocean.

The difficulties in the way of accepting any one of these hypotheses being pointed out, it was shown that the rocks in question include a number of well-marked and lithologically distinct groups, each of great thickness, giving evidences of successive depositions interrupted by foldings and erosions, and extending over vast periods of eozoic time. The new hypothesis proposed by the writer to explain the origin of these rocks, unlike the first three named, starts from the basis of a solid earth. The globe consolidating at the center, left, it is conceived, a superficial layer of basic silicates, which has yielded all the fixed elements of the earth's crust. This layer formed the first land and the floor of the primeval sea, the acid waters of which, permeating and partially decomposing it, became thereby chemically neutralized. This last-cooled layer, mechanically disintegrated, saturated with water, and heated by the central mass, was the source of mineral springs holding in solution the silicates which built up the ancient gneisses and similar rocks.

This hypothesis of their origin was illustrated by the history of granitic veins, and by the derivation of quartz and orthoclase and of zeolites (which are hydrated feldspars) by aqueous action from basic rocks. All such deposits are due to survivals of the process which generated the gneissic rocks. The hypothesis of their formation from materials brought to the surface by mineral springs from the primitive basic layer, affords, it was claimed, the elements of a complete and intelligible explanation of the origin of the eozoic rocks, and was first suggested by the

writer in 1874 (Chemical and Geological Essays, pp. 298, 299). It may be conveniently designated as the *crenitic* hypothesis (from the Greek κρηνίτης, pertaining to springs or fountains). All veinstones and deposits from mineral springs are of crenitic origin.

It was farther shown that the upward lixiviation of the primitive mass, and the deposition over it of an acidic granite-like rock would leave below a highly basic material, and that the division of the mass thus established would correspond to that of the trachytic and doleritic magmas which have been conjectured to be the sources of two great types of eruptive rocks. Inasmuch, however, as according to the present hypothesis these two layers of basic and acidic matters are the results of aqueous action, and not of an original separation in a plutonic mass, as imagined by Phillips and Durocher, their composition would be subject to many local variations. The secondary origin of the materials of eruptive rocks has long been maintained by the writer, who finds the source of certain of them in the underlying basic layer left by the partial solution of the primitive mass; which now forms, it is believed, a plastic stratum between the solid anhydrous nucleus and the solid crust.

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EDITORS' TABLE.

EDITORS A. S. PACKARD, JR., AND E. D. COPE.

—— Professor A. Weisman, who has recently published a brochure on inheritance, and another on the duration of life, has now attacked from the biological, *i.e.* inductive point of view, those ultimate problems which so often arise in the minds of thoughtful men, What is life and death? His tract was when first read as an academic programme, entitled "On the Perpetuity of Life." It is claimed by the author that in the protozoa, or one-celled animals, we cannot speak of a natural death in connection with these lowest organisms, for there is no observable end to their phases of development which is comparable to the death of the higher, many-celled animals. In the protozoa there is no origin of new individuals resulting in the death of the parent, but as seen in the self-division of any infusorian, neither of the new individuals is the older or younger. Thus there arises an unending series of individuals, each one of which is as old as the species itself, each

one having the capacity of an unlimitable existence and of undergoing an indefinite number of fresh acts of self-division.

That the higher organisms, or the many-celled animals have not this power, Weismann thinks, is owing to their multicellular structure, and to the division of labor between the cells of their bodies.

The essay is certainly a very suggestive one, as is indeed nearly all of Weismann's work. The space at our command only permits us to give the author's conclusions:

1. Natural death alone occurs in many-celled organisms, the one-celled forms do not possess it; the process of encysting of the latter is in no wise comparable to death.

2. Natural death appears to first occur in the lowest Metazoa, *i.e.* the Orthonectides, through the adjustment (normirung) of the cells collectively in one generation, and of the somatic or peculiarly body-cells in a limited existence; then also in the higher Metazoa the somatic cells adjust themselves first to several, and then many generations, and thus are correlated with or adjusted to an extended existence.

3. This adjustment goes hand in hand with the differentiation of the cells of the organism according to the principle of division of labor in reproductive and in body-cells, and was accomplished by a process of selection.

4. The biogenetic fundamental law applies only to the many-celled beings, but has no application to the unicellular forms; this also bears a relation on the one hand to reproduction through division in the monoplastids (one-celled forms), on the other on the necessity through sexual reproduction of the relation of a one-celled developmental stage in the polyplastids (many celled).

5. As in death itself, so also the shorter or longer duration of life is solely a matter of adaptation; death is not dependent on a primitive quality of living matter; it also is not especially connected with reproduction, nor is it indeed a necessary consequence of the same.

Finally, our author maintains that life is a perennial, not a periodically interrupted state. When first introduced on the earth it went on without interruption; only its forms changed, and the individuals of all, even the highest forms, which are living to-day, have descended in unbroken continuity from the oldest primæval forms; there is a complete continuity of life.

—— The study of these problems, we would add, will tend to throw light on the life and death of species, of genera, families and orders of plants and animals.

At present the causes of the extinction of the life of species and higher categories are interwoven with those of the origin of species. To say that species like individuals have their appointed time is a mere platitude. It is now beginning to be understood that geological extinction was due mainly to changes of land and water in the growing continents, and to consequent lack of adaptation to the new conditions on the part of those organisms which were unsuccessful in the struggle for existence. Thus the apparent lack of continuity in a part of the life which stocked the earth in former ages was due to the lack of adaptation. But life as a whole has always been continuous, perennial; the breaks were the result of more or less local breaches of continuity in the continent-making processes. The youth, maturity and senility of individuals is, as Hyatt has shown, paralled by the youth, maturity and decline of the types to which they belong; and we can now begin to see how correlated and continuous are the phases of what we call life and death in the material world, and throughout all time, and all forms of life.

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RECENT LITERATURE.

BRAUER'S STUDIES ON DIPTEROUS LARVÆ.[1]—This is a most valuable addition to our knowledge of the early stages of the Diptera, and is the result of a large acquaintance with the early forms of this order, by one who has for over twenty years devoted special attention to these insects. In his "Monographie der Œstriden," 1865, but more especially in his "Kurze Characteristik der Dipteren-larven," 1869, wide gaps in our knowledge of the transformations of the Diptera were filled. And now with the present work, in addition to the observations of the earlier entomologists, and the recent writings of Fritz Müller, Dewitz and Wierzejski on the transformations of the Blepharoceridæ, and of Handlirsch on the Nemestrinidæ, we are in possession of a knowledge of the larval stages of one or more species of all the natural families of Diptera. After lengthy remarks on the systematic relations of different groups of Diptera, based on the larval characters, Brauer states that the typical, inherited feature in the entire group of Dipterous larvæ appears to be the position of the brain (kopfganglien), whether it is contained in a head-capsule, or free, *i. e.*, far behind the mouth or immediately behind the chitinous cap-

[1] *Die Zweiflügler des Kaiserlichen Museums zu Wien.* III. Systematische studien auf Grundlage der Dipteren-larven nebst einer zusammenstellung von Beispielen aus der Literatur über dieselben und beschreibung neuer Formen. Von Prof. Dr. Friedrich Brauer. Mit 5 Tafeln. Besonders abgedruct aus dem XLVII Bande de Denk. Math.-Naturw. Cl. k. Akad. der Wissensch. Wien, 1883. 4to, pp. 100.

sule (kiefer-kapsel), supporting some of the mouth-parts, and containing the œsophagus. Less important characteristics are then enumerated. A very unsafe character is the number of visible body-segments, since in some they are often not true segments, but intermediate rings arising from the lengthening of the membrane connecting the true segments (Polytoma); in others a secondary annulation of the single segments, whose true limits in the living animal can be best determined by the markings repeated on the true segments (Ceraplatus); or they appear to be reduced in number through the coalescence of the anterior or hinder segments (Blepharocera, Liponeura, Culex, Simulium, etc.) or any external segmentation is almost wholly wanting (Eristalis, Microdon, etc.).

Thus we may count in the Polytomous larvæ behind the maxillary capsule (we do not know how better to translate *kiefer kapsel*) 20–21 segments; in the Cecidomyid larvæ 13 segments; in the Tabanidæ and Stratiomyidæ 11 segments; in the Leptidæ 11–12; in the Tipulidæ 12, as also in the Asilidæ, Nemestrinidæ and in the Muscidæ.

"In the Muscidæ, Æstridæ, etc., the larval body is regarded as 12-segmented. This is based on the view that the antennal segment enclosing the mandible (mundhaken), which in all the cyclorrhaphous larvæ remains membranous, while in the Orthorrapha (except Lonchoptera) it is above firm and chitinous, forming a ring bearing the antennæ and jaws, which we have termed the kiefer-kapsel. On the other hand the cyclorrhaphous larvæ have, behind the antennal-bearing segment, only eleven true segments—three thoracic and eight abdominal segments. The first or antennal segment must especially be regarded as complex, since it encloses the kiefer-kapsel and bears the antennæ. As to the disappearance of a ninth abdominal segment, which is distinct in some larvæ, the embryonic development must give the clue. though the terminal segment in a good many forms is plainly formed of two segments (Blepharoceridæ, etc.)."

While the view as to the head-segments is a practical one, and of value from a systematic point of view, we wonder that Dr. Brauer has not adopted the broad morphological view, based on the well-known facts in the embryology of Diptera, that the head of any dipterous insect is at first, like that of other insects, composed of four segments, *i. e.*, an antennal, mandibular, first maxillary and second maxillary; the peculiar modification in the dipterous larvæ being the result of degradation; the adaptation of form and structure in these larvæ to their varying surroundings being very marked. It seems to us that the larvæ of Eucephala (Chironomus, etc.) represent the primitive form of dipterous larvæ, the headless forms, or maggots, being the result of adaptation. It was, however, Dr. Brauer's intention not to enter into these questions in the present essay, but simply to de-

scribe them for the practical needs of the entomologist. The homologies of the larval mouth-parts with those of other insects he does not discuss, though he apparently does not consider them to show such homologies; though Weismann regarded the mouth-parts of the muscid and other larvæ to be consolidated mandibles.

Brauer then lays down the characters of the dipterous larvæ in general, and discusses the value of the larval characters in classification. We have no space to condense the statements as to the characteristics of the metamorphosis of the different groups, or to present the convenient tabular view on p. 11. We note, in passing, that Dr. Brauer makes no reference to the Pulicidæ, which he evidently does not consider as Diptera; but with larvæ so closely resembling the encephalous larvæ (Mycetophilidæ), we do not see how some discussion of their affinities or even structure could well have been avoided in an essay of the scope of the present one.

Then follows a lengthy and interesting tabular view of the nervous systems of the larval as compared with the adult Diptera. This is succeeded by a section on the characters of the sub-orders and families; this occupies the greater part of the work, and is of prime importance. It is followed by short descriptions of a few larvæ of the families Tabanidæ, Leptidæ, Dolichopidæ and Empidæ.

The systematic list of descriptions of known dipterous larvæ with the bibliographical references (pp. 46–93), will be of the greatest use, especially to American entomologists; its compilation was a laborious undertaking; it appears to be very full and accurate, though we notice the omission of any reference to the description and figures of *Chironomus oceanicus* Pack., but such omissions must be few. The full index to the genera is a valuable feature. The plates, like all the author's artistic work, are excellent.

The Diptera are, without doubt, the most difficult order of insects, and Dr. Brauer, in giving us these results of ten years' labor on their larval forms, has laid entomologists under lasting obligations. The work will be of value to the systematist as well as to the economic entomologist, while the general biologist will find it a storehouse of facts bearing on the evolutionary problems of the day.

DeCandolle's Origin of Cultivated Plants.[1]—The aim of the author in this work has been to inquire into the condition and habitat of each species before becoming cultivated. Over how wide a range of inquiry, antiquarian, historical and botanical this has led the learned author, may be seen by glancing over the

[1] *Origin des Plantes cultivées.* Par Alph. DeCandolle. Bibliotheque scientifique internationale, XLIII. Paris, 1883. 12mo, pp. 378.

footnotes. The number of cultivated species mentioned amounts to 249, but the author adds that by the end of this century there will be about 300 species out of 120,000 or 140,000 species of the vegetable kingdom; but this is more than in the animal kingdom, where out of "some millions" [*sic*] of species there are only 200 species of domestic animals.

The author remarks in the opening chapter that selection—that great factor that Darwin has had the merit of so happily introducing into science—plays an important rôle in agriculture once established; but at every epoch, and especially in the beginning, *the choice of species has more importance than the selection of varieties.* As to the earliest beginnings of the culture of useful plants in temperate Europe and Asia, the following extracts are of interest:

"In spite of the obscurity of the commencement of culture in each region, it is certain that the earliest date of cultivated plants is very different. One of the oldest examples of cultivated plants is, in Egypt, a drawing representing the fig, in the pyramid of Gizeh. The epoch of the construction of this monument is uncertain. Authors have varied between 1500 and 4200 years before the Christian era! If we suppose it to be about 2000 years, it will be an actual antiquity of 4000 years. But the construction of the pyramids could only have been carried on by a numerous people, organized and civilized up to a certain point, having, consequently, an established agriculture, which should make the antiquity much higher, at least some centuries.

"In China, 2700 years before Christ, the emperor, Chen-nung instituted the ceremony in which each year he sowed five kinds of useful plants: rice, soja, wheat and two kinds of millet. These plants must have been cultivated for some time, in certain localities, to have attracted the attention of the emperor. Agriculture appears, then, to have been as ancient in China as in Egypt. The constant relations of this last country with Mesopotamia lead us to suppose the existence of a culture almost contemporaneous in the regions of the Euphrates and of the Nile.

"Why should it not have been as ancient in India and in the Indian archipelago? The history of the Dravidian and Malayan peoples does not go back very far, and presents some obscurity; but there is no reason to believe that agriculture did not begin among them a long time since, particularly on the borders of rivers.

"The ancient Egyptians and the Phœnicians have propagated many plants in the region of the Mediterranean, and the Aryan peoples, whose migrations toward Europe commenced somewhere near 2500, or at least 2000 years B. C., have spread about several species which were already cultivated in Western Asia. We shall see, in studying the history of some species, that already certain plants were probably cultivated in Europe and in the north

of Africa. There are some words of languages anterior to the Aryan, for example, Finnish, Basque, Berber and Guanch (of the Canary isles), which point to this conclusion. As to the remains called Kjokken möddings, the ancient stations in Denmark have furnished no proofs of the existence of agriculture, and likewise no proof of the possession of any metal. The Scandinavians of this epoch lived principally on fish, game and perhaps incidentally indigenous plants, like the cabbage, which are not of a nature to leave any traces in refuse or rubbish heaps, and which might have passed into cultivation. The absence of metals does not presuppose, in this northern country, an antiquity greater than the age of Pericles, or even of the prosperous period of the Roman republic. Afterward when bronze became known in Sweden, a region far removed from the civilized world, agriculture was completed by its introduction. There are found in remains of this epoch the carving of a plough drawn by two oxen and driven by a man.

"The ancient inhabitants of Eastern Switzerland, where they had instruments of stone and not of metal, cultivated several plants, some of which were natives of Asia. M. Heer has shown in his admirable work on the palafittes (lake-dwellings) that they had communication with the countries situated among the Alps. They could also have received cultivated plants through the Iberians, who occupied Gaul before the Celts. At the epoch when the lake-dwellers of Switzerland and of Savoy possessed bronze, their husbandry was more varied. It seems also that the lake-dwellers of Italy, when they had this metal, had a smaller number of species under cultivation than those of the lakes of Savoy, either from their higher antiquity or from local circumstances. The remains of the lake-dwellings of Laybock and of Mondsee, indicate a quite primitive agriculture—no cereals at Laybock and a single grain of wheat at Mondsee. The slightly advanced state of agriculture in this eastern part of Europe is opposed to the hypothesis, based on some statements of the ancient historians, that the Aryans had first sojourned in the region of the Danube, and that Thrace was civilized before Greece. In spite of this instance agriculture appears, in general, to have been more ancient in the temperate portion of Europe than we would be led to believe by the Greeks, who were disposed, like certain moderns, to make all progress originate from their own nation."

The first chapter of Part I treats of how and at what epochs the culture began in different countries; the preceding extracts are from this chapter. In the second chapter the author concludes that in order to ascertain the origin of the cultivated species, we should combine botanical, archæological, palæontological, historical and linguistic methods.

The second part comprises most of the volume, and treats of the origin of those plants cultivated for their racemes, bulbs or

tubers; those cultivated for their stalks or leaves; those useful from their flowers or the parts enveloping them; fruits and grains. The third part is devoted to a résumé and conclusions with valuable statistics.

The work is, of course, authoritative and is, moreover, exceedingly interesting. With it should be read the lengthy review of the work, by Dr. Asa Gray and J. Hammond Trumbull, in the *American Journal of Science* for April and May, 1883, containing valuable additions relative chiefly to American plants.

JACKSON'S VEGETABLE TECHNOLOGY.[1]—This is evidently a most carefully prepared bibliography of economic botany, and must prove of great utility. The author purposely excluded all books devoted to silk and cochineal, as not being strictly within the limits of the title as settled by the Index Society; and "most reluctantly the subject of the vine, its culture and products, simply on the ground of its enormous extent." The bibliography of the vine, he adds, in all its bearings would require a lifetime for its compilation. He has also excluded books and papers of simply horticultural, therapeutic, chemical, commercial or manufacturing interests, unless they contained a sufficient account of the raw products, its cultivation or whence obtained to justify their citation. The author does not claim that the work is complete saying that "a complete bibliography of economic botany would require the labor of years." The number of entries in the present book is 3580, exclusive of translations and different editions. The index fills nearly 100 pages, is comprehensive, and adds greatly, of course, to the usefulness of the work.

SMITH'S DICTIONARY OF ECONOMIC PLANTS.[2]—The scope of this work is sufficiently indicated by the title; it is not confined to the cultivated plants. The author was officially connected, for more than forty years, with the Kew Gardens, and was thus practically acquainted with the largest collection of living plants, exotic and native, ever brought together. In regard to those points which DeCandolle has worked out with such care, the present work is deficient, still it is a useful book, arranged in the form of an index or dictionary.

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Nipher, F. E.—On the expression of electrical resistance in terms of a velocity. Ext. Trans. St. Louis Acad. of Science, Vol. IV, 1884. From the author.

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[1] *Vegetable Technology.* A contribution towards a bibliography of economic botany, with a comprehensive subject-index. By BENJAMIN DAYDON JACKSON. Founded upon the collections of George James Symonds. London, published for the Index Society. 1882. 8vo, pp. 355.

[2] *A Dictionary of popular names of the Plants which furnish the natural and acquired wants of man in all matters of domestic and general economy. Their history, products and uses.* By JOHN SMITH. London, Macmillan & Co. 1882. 8vo, pp. 45[illegible]

Barrois, Chas.—Memoire sur les Schistes Metamorphiques de l'ile de Croix (Morbihan). Ext. des Ann. de la Soc. Geol. du Nord, Lille.

—Memoire sur les Dictyospongidæ des Psammites du Condroz. Ext. idem. Both from the author.

Lydekker, R.—Palæontologica Indica, Ser. x, Vol. III, Part I. Additional Siwalik Perissodactyla and Proboscidea. Calcutta. 1884. From the author.

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Cook, G. H.—Annual report of the State Geologist of New Jersey for 1883. Camden, 1883. From the State geologist.

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—Remarque sur les affinités naturelles de Poissons Malacopterygiens Abdominaux.

—Sur le genre Ptychogaster (Pomel), Chelonien fossile de Saint-Gerand-le-Puy.

—Nouvelles Archives du Museum D'Histoire Naturelle. Notice sur la Grande Salamandre du Japan, *Cryptobranchus japonicus* V. D. Hoeven.

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Whitfield, R. P.—Notice of some new species of primordial fossils in the collections of the Museum of Nat. Hist. N. Y. Ext. Bulletin of the Amer. Mus.

Hitchcock C. H.—Geological sections across New Hampshire and Vermont. Ext. Bulletin of the Amer. Mus. Both from the Amer. Mus. N. Y.

Whitfield, S. H.—Two new and diverse types of Carboniferous Myriapods.

—The species of Mylacris, a Carboniferous genus of Cockroaches. Both in memoirs of the Boston Society Nat. Hist., Vol. III, No. IX. From the author.

Parker, W. K.—On the skeleton of the Marsipobranch Fishes. Part I. The Myxinoids (Myxine and Bdellostoma). Part II. Petromyzon. Ext. Philos. Trans. Royal Soc., Part II, 1883. From the author.

—On the structure and development of the skull in the Crocodilia. Ext. Trans. Zool. Soc., Vol XI, Part IX, 1883. From the author,

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GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

On the Fossil Flora of Greenland.—Through Professor O. Heer's researches, 617 species of fossil plants are now known from Greenland, of which 335 belong to the Cretaceous and 282 to the Tertiary epoch. The Cretaceous plants occur in three distinct stages, described as the beds of Kome, Atane and Patort.

In the *Kome beds* vascular Cryptogamia (especially *Gleicheniæ*) and Gymnosperms (namely, ten Cycadeæ, forms analogous to the *Zamiæ*, and twenty-one Conifers, including five Sequoiæ) are found almost exclusively. The Dicotyledoneæ are represented only by a single species, *Populus primaeva*. The general character of the flora of these deposits, which may be compared with the Urgonian strata, indicates a subtropical climate.

In the *Atane beds* there occur, besides vascular Cryptogamia (some of which are arborescent) and Gymnosperms (eight Cycadeæ, twenty-seven Conifers; among others *Cycas steenstrupi* with well-developed carpels), ninety species of dicotyledoneæ, the appearance of which was very sudden. Here, also, the flora indicates a subtropical climate. The Atane beds may be compared with the Cenomanian strata.

In the *Patort beds*, twenty vascular Cryptogamia, eighteen Gymnosperms, five Monoctyledoneæ, and sixty six Dicotyledoneæ have been found. Among the Conifers the most abundant species is *Sequoia concinna* Heer (branches and fruits), nearly related to the Tertiary *Sequoia couttsiæ; Sequoia langsdorfii* Brgr., a Tertiary species, is also frequently met with. The Dicotyledons consist of birches, alders, elms, fig-trees, walnuts, oaks and planes (the last two genera in great numbers); then come laurels, cinnamons, azalias, magnolias, &c., &c. The Patort beds also contain marine animals, which enable us to make an exact comparison with the deposits of other countries, and approximate them to the Upper Senonian of Europe, consequently to the Upper Chalk.

The Tertiary flora of Greenland is derived either from an Eocene deposit or from Lower Miocene beds. It includes in all 282 species, two of which also appear in the Chalk; twenty others are derived from Cretaceous plants, but the rest show no relationship to the Cretaceous flora. Moreover, tropical forms are entirely wanting, so that the climate had been profoundly modified; the mean temperature of the year in Greenland at the epoch of the Lower Miocene must have been about 12° C. (= 53° ·6 F.), as evidenced by the presence of two fan-palms, magnolia, Sapindus, Dalbergia, &c. The Tertiary flora of Greenland has 114 species like those of Europe.—*Bibl. Univ., Arch. des Sci. October 15th, 1883, p. 355.*

Geological Notes.—*General.*— MM. Mojsisovics and Neumayr (Beitr. z. Palæont. Ost. Ungarns, 1883) describe the trilobites of Bohemia.

Cambrian and Silurian.—W. Dames describes (Richthofen's China, Palæontology) fifteen species of trilobites from the Cambrian of Liau-Tung, near the Corean boundary. E. Kayser (*op. cit.*) describes a few Cambrian Brachiopoda from Liau-Tung, and adds several new species to the fossils of the Middle and Upper Silurian of the mountains of Tshau-tien. In the same work G. Lindström describes numerous species of corals from the Upper Silurian of Tshau-tien.——J. F. Whiteaves has described numerous fossils from a series of dolomites that lie between the Niagara and Onondaga formations, and are known in Canada as the "Guelph formation." The species include three corals, three brachiopods, sixteen lamellibranchs, two gasteropods and a trilobite that are new to science.

Devonian.—M. D. Œlhert (Bull. de la Soc. Geol. de France) describes four species of Chonetes known from the Devonian of

the west of France, and discusses the relationships of the genus. The same geologist also describes two new species of Acrocutia, *A. protei* and *A. sileni*, from the Lower Devonian of Mayenne. ——E. Kayser (Richthofen's China) describes fourteen species of Devonian brachiopoda from Southwest China. Fourteen species of fossils were previously known from the Chinese Devonian.

Carboniferous.—C. Schwager (Richthofen's China) describes the flora of the Carboniferous strata of China and Japan ——E. Kayser (*op. cit.*) describes the collection of Upper Carboniferous fossils made by Baron Richthofen at Lo-Ping. This consisted of 1000 specimens and over fifty species, including *Leptodus richthofeni*, a new genus and species of fishes, *Phillipsia obtusicauda*, four nautili, two or three Orthoceratidæ and numerous lamellibranchs and brachiopods.

Jurassic.— M. Sauvage (*loc. cit.*) describes the fishes of the genus Pleuropholis, with the following new species, *P. egertoni*, *P. thiolleri*, *P. obtusirostris*, *P. lienardi*. The genus was first known from the Purbeck beds of England, and has since been found in the Lower Kimmeridge of Cervin, France. ——M. P. J. Van Beneden (Bull. de l'Acad. Roy. de Belg.), has a note upon some cetacean bones, consisting of four vertebræ and two fragments of ribs, found in the Oligocene phosphatic beds between the Elbe and the Weser. He determines these bones to belong to two species of whalebone whales, of which the larger, *Pachycetus robustus*, was equal in size to *Balænoptera rostrata*, while the smaller, *P. humilis*, equaled *B. juddi*. With these cetacean remains occurred the sternebra of a great terrestrial mammal, probably that of *Lophiodon rhinoceroides* Geinitz. The same beds yield numerous mollusks and teeth and vertebræ of plagiostomes. The latter had been referred to *Lamna cuspidata*, *L. elegans* and *Myliobates dixoni*.—A. Locard (Arch. Mus. d'Hist. Nat. de Lyon, 1883), describes the Pliocene fresh-water shells of the basins of Lakes Tiberias, Antioch and Homs, seventy-one species in all, mostly new. Twenty-nine belong to Unio, thirteen to Limnæa and nine to Melanopsis. Melania and Dreissena are each represented by two species, Planorbis by one.

Tertiary.—L'Abbé Bazin (Bull. de la Soc. Geol. de France, 1883), has described the Echini of the middle Miocene of Brittany. The new species are *Echinocyamus lebescontei*, *Scutella circularis*, *Nucleolites dinanensis*, *Echinanthus armoricus*, *Echinolampas dinanensis*, *Brissus humberti* and *Spatangus brittannus*.——Palæontologica Indica, series x, volume ii, part 6, treats of the Siwalik and Narbada Carnivora. *Mellivora sivalensis* is known from three specimens obtained near the Ganges valley, while another ratel occurs in the Punjab. *Mellivorodon palæindicus* was intermediate in size between the ratel and the glutton, but probably more nearly allied to the former. Mr. Lydekker unites under Lutra several of Gray's genera, and adds to the already numerous recent and extinct

species *Lutra bathygnathius*. To the bears he adds *Ursus theobaldi*, which may probably be the ancestor of the aswail (*U. labiatus*), but had better developed molars. *Hyænarctos punjabensis* and *H. palæindicus* are considered to be distinct from *H. sivalensis*. *Amphicyon palæindicus* is added to the Canidæ and *Viverra durandi*, the largest known civet, to the Viverrideæ; *Hyæna colvini* is separated from *H. sivalensis*, and is said to approach Crocuta, and *H. macrostoma* constitutes an important link between the more typical members of the genus and the viverroid and canoid Carnivora. To the Felidæ are added *Æluropsis annectans*, and *Felis brachygnathus* and the occurrence of a hyænodon (*H. indicus*) in the Siwaliks is mentioned as a matter of extreme interest.——M. Lemoine (Bull. de la Soc. Geol. de France, 1883), describes *Neoplagiaulax eocenus* and *N. marshii*, from the Lower Eocene near Rheims. The genus is distinguished from Plagiaulax by the presence of a single premolar only on each side. M. Lemoine considers it as intermediate between Plagiaulax and the recent Bettongia.

MINERALOGY.[1]

Native Iron from New Jersey.—As a deep well was being bored on the Van Horn farm, in Raritan township, Middlesex county, N. J., about three miles east of New Brunswick, in Triassic red shale, it was noticed that when the drill was raised from the well there were numerous particles and small grains of iron adhering to its lower end. This attracted the attention of Mr. J. F. Hotchkiss, of Plainfield, who found that particles of native iron occurred not only in the well, but in the surface earth about the farm.

An analysis of an unwashed sample gave J. B. Stillman:

Iron	Phosphorus	Sulphur	Silica	Titanic acid
76.12	0.27	1.23	11.20	0.21

Professor Cook also made repeated visits to the farm and picked out particles of metallic iron with a magnet, being satisfied that there was no mistake or deception in the case.

He states[2] that while a few of the grains are as large as pin heads, most of them are smaller and much is fine dust. Some of those brought up by the drill are but little oxidized on the surface, while those found in the soil are rusted, often so completely as to leave only a small particle of metallic iron in the center of the rusted grains. The metal flattens under the hammer, and is evidently native. Traces of copper are reported to occur in the iron.

The observation is of great interest. It is now well known that metallic iron occurs in trap, but its discovery in a sedimentary

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Geolog. Survey of N. J., Annual Report for 1883, p. 162.

shale introduces new considerations. It may have been reduced by organic substances, as supposed by Hausman and Karsten in the case of certain analogous instances in Germany, or it may have been washed out of a trap dyke, or again it may be the result of meteoric action in Triassic times. Being found at a depth of fifty feet in the red shale, it cannot belong to the drift, but is evidently of Triassic age. The subject is very suggestive.

Flexible Sandstone from Pennsylvania. — H. C. Lewis[1] records the finding of itacolumite, or flexible sandstone, at two localities in Pennsylvania, in Paradise township, Lancaster county, at the "Wolf rocks," and in White Marsh township, Montgomery county, north of Lafayette. In both localities the flexibility, which is much less than in the North Carolina rock, is evidently due to the decomposition of the cementing material in a formerly inflexible sandstone. By the removal of the feldspar each thin layer of sand is separated by small distances from the layers above and below, thus allowing of limited flexibility. This explanation probably applies to all flexible sandstones. The "ball-and-socket" theory of the grains of sand is of course absurd.

Some Maine Minerals.—G. F. Kunz[2] states that nearly 1500 crystals of tourmaline have been obtained from "Mount Apatite," near Auburn, Maine. These are often brilliantly polished, and are characterized by their beautiful pale color. Colorless, light pink, light blue, bluish-pink, pale green and other colors occur in different crystals or are sometimes nearly all seen in a single tourmaline. Good gems have been cut from these crystals.

The apatite of the same locality is finer in color and form than elsewhere in America. It has the same pale shades of pink, blue, purple and green as the tourmaline found with it, and has been set for gems.

Other associated minerals are lepidolite, quartz, albite, orthoclase, beryl, garnet, cassiterite, gummite, autunite, muscovite, leucopyrite, cookeite, biotite, amblygonite and zircon.

At Gorham some unusually fine crystals of andalusite have been found. The color is mostly a brownish flesh tint, and sometimes grayish-pink. Occasional translucent pieces occur in the nearly opaque crystals.

The interesting fact was observed that while the hardness on the side of the prism is 6–6.5, the hardness on the basal plane is 7.5. The crystals occur in a quartzite vein in a brown mica schist, in which are small crystals of pyrrhotite.

Natural Nitrous Oxide, or Laughing Gas.—It is stated[3] that "the great Sierra tunnel, at Tioga, has developed the presence, in the indurated mudstone, silicious limestone and arena-

[1] Proc. Acad. Nat. Sciences Phila., 1884.
[2] *Amer. Jour. Science*, April, 1884.
[3] *Lundy* (California) *Index.*

ceous shales of Tioga hill, of protoxide of nitrogen, the exhilarating gas known as 'laughing gas,' with traces, also, of the nitrates commonly associated with several of the metals. As is well known, the inhalation of protoxide of nitrogen produces exhilaration to intoxication, an irresistible impulse to muscular exertion, insensibility to pain, and develops the characteristic propensities of the individual to a striking degree. Air is forced in the great Sierra tunnel through wooden boxes, and the distance, leakage and friction being great, the supply was inadequate, and hence the accumulation of this nitrous gas at the header, the inhalation of which had the characteristic effect upon those working there as soon as one of them got an overdose. A muscular miner was brought out fighting, and it took four men to hold him until he returned to consciousness in the open air. A mail carrier went in and got a dose, and, when brought out, seized a couple of bars of iron, lashed them to his feet with wire, leaped over the dump and went sailing down the mountain over the snow."

TIN FROM NORTH CAROLINA.—A valuable vein of cassiterite has been found at King's Mountain, a small town in Shelby county, N. C. The vein discovered is between four and five feet in thickness, and has been struck in two places. The ore yields 869.2 pounds of tin per ton of ore. The finest ore in the English tin mines, at Cornwall, yields less than half this per cent of tin to the ton, and great expectations are therefore aroused concerning this new vein. Specimens of the ore, marked "unknown," were on exhibition at the Boston Exposition last summer, but it is only lately that the place of the vein has been made public.

Tin occurs sparingly at many other places in the United States, but has never been worked with profit.

SWEDISH MINERALS.— *Mangan-brucite.*—L. J. Igelström[1] describes some small grains of a honey-yellow or brownish-red color which occur in the hausmannite ore at the Jacobsberg mine in Wermland, Sweden. They are devoid of cleavage and are often colorless within, while deeply colored on the outside. Water is set free on the application of heat.

Analysis gave:

MgO	MnO	H_2O		
57.81	14.16	28.00	=	99.97

The formula (Mg, Mn) $[HO']_2$ is given, and the name *Mangan-brucite* proposed. Apparently, however, it is a mere alteration product.

Talc-triplite.—The same author finds in the lazulite of Horrsjöberg certain small yellow or yellowish-red translucent amorphous grains which, although intimately mixed with other minerals, he

[1] Oefvers. af Kgl. Vet. Akad. Förhandl., 1882, pp. 83–91.

regards as a new species. Before the blowpipe it melts to a black, metallic glass. Soluble in acids. Composition:

PO_5	FeO	MnO	CaO	MgO
32.82	16.12	14.86	14.91	17.42

Berzeliite.—Many rare minerals accompany the hausmannite of Sweden. Native lead, native copper, monimolite, atopite, ganomalite, chondroarsenite, hyalophane, ekdemite, hedyphane, braunite, manganophyllite, tephroite, manganosite, pyrochroite, manganbrucite, barylite, rhodonite are among the species found. Some of the above are very questionable species. Recently Igelström[1] has observed the rare mineral berzeliite in the hausmannite of Nordmark. It occurs both as a vein of a yellow massive material, and disseminated in grains through veins of calcite.

Analysis of the pure yellow material gave:

As_2O_5	CaO	MgO (with some MnO)	Pb and Cl
57.80	25.25	16.95	traces

The formula given by Dana (Mineralogy, p.544) is adopted.

Another variety of berzeliite, found many years ago at Longban has the formula of an orthoarseniate and is singly refracting, while that now described is doubly refracting. The physical characters of the two minerals are identical.

M. E. Bertrand[2] has made an optical examination of the two varieties of berzeliite, and finds that while the optical characters of the Longban variety are vague, differing in different parts of the mineral, those of the Nordmark variety are well marked and constant. The acute bissectrix is positive and the negative obtuse bissectrix is perpendicular to certain plane faces. It probably belongs, therefore, to the orthorhombic system.

Ganomalite.—M. Sjögren[3] has examined the silicate of lead and lime, to which Nordenskiöld has given the name ganomalite. He has found that the crystals are tetragonal, and show strong double refraction with a positive axis. As the cross traversing the rings is sometimes dislodged, more or less, he thinks it possible that the mineral may be biaxial with a very small optic-axial angle. Two analyses are given, the first of the variety from Longban, the second of that from Jacobsberg:

SiO^2	PbO	CaO	MnO	Gangue
20.40	69.42	9.89		0.29
18.33	68.80	9.34	2.29	1.24

Tephroite.—Very small crystals of tephroite have recently been found at Longban. A crystallographic investigation has shown that all the forms are those known in chrysolite, and that, as

[1] Bull. Soc. Min. de France, 1884, p. 27.
[2] *Loc. cit.*, p. 31.
[3] Geol. Fören. d. Stockholm, 1883.

Descloiseaux announced in his "Manuel de Mineralogie," tephroite and chrysolite are isomorphous.

Pyrosmalite. — Alex. Gorgen[1] communicates an analysis of pyrosmalite from Dannemora which is of considerable interest in that it shows a close analogy in composition with a silicate of manganese from Adervielle, Hautes Pyrenees, described by Bertrand under the name of Friedelite.

The oxygen ratios of the two minerals are as follows:

	SiO_2	MnO FeO CaO MgO	Cl Fe	H_2O
Pyrosmalite	18.24	11.56	0.84	7.60
Friedelite	18.37	11.42	0.80	8.53

Both minerals are remarkable for the energy with which they retain their chlorine and water. Both are hydrated chlorosilicates, and present chemically the same analogy as Bertrand has shown to exist between their crystalline form and their optical properties.

HAYDENITE.—H. N. Morse and W. S. Bayley[2] have reëxamined the variety of chabazite known as haydenite, found in the gneiss quarries near Baltimore. Cleaveland named the species in 1822 but its independence as a separate species was doubted until Levy, in 1839, showed it to be, as he supposed, monoclinic. But Dana afterwards showed Levy to be in error, demonstrating that the mineral was rhombohedral, occurring in scalenohedrons. He held that haydenite and chabazite were identical, although the analyses of the two minerals, yet made, differed. The analyses of Silliman and Delesse differed from one another and from chabazite.

The composition, as now ascertained, is (mean of two analyses):

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	BaO	K_2O	H_2O
49.24	18.07	0.84	5.16	0.86	1.47	3.00	21.31 = 100

By regarding the iron as in the ferrous condition and, like magnesium and barium, replacing calcium, the analysis closely agrees with the recorded analysis of chabazite and with Rammelsberg's formula for that mineral. Haydenite is thus undoubtedly in all respects identical with chabazite.

BOTANY.[3]

AN OBSERVATION OF THE FERTILIZATION OF THE GERM CELL OF EQUISETUM ARVENSE.—The spores were started on the 30th of April. For some reason, for a time growth did not seem healthy and they were neglected until the last of June, when I found that they had developed large prothallia, both male and female, the latter

[1] Bull. Soc. Min. de France, 1884, p. 58.

[2] *Amer. Chem. Journal*, March, 1884.

[3] Edited by PROF. C. E. BESSEY, Ames, Iowa.

much larger, and with longer and more forking branches. Young plants were first noticed June 30th, exactly two months from the time of sowing the spores.

On examining the prothallia, numbers of fresh archegonia were found at the base of the branchse, the germ cell being imbedded in the tissue of the prothallium.

On the third of July, I was fortunate enough to witness the entrance of the antherozoids into the archegonium.

Finding an archegonium that from its appearance was evidently on the point of opening, a portion of a male-prothallium, containing a ripe antheridium was placed upon the same slide.

For some time before opening, the four upper cells of the archegonium became much distended with water (Fig. 1) so as to present a somewhat bulbous appearance. These four cells gradually separate until finally they diverge widely. This open-

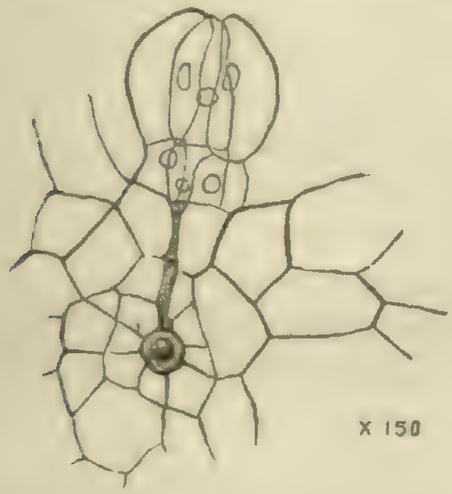

FIG. 1.

FIG. 2.

ing is accompanied by the discharge of a considerable quantity of transparent mucilage that collects in drops near the opening.

Within a few moments after the archegonium opened, an antherozoid made its way to the opening, and penetrated a short distance, but for some reason did not remain. Very soon, however, a large number collected around the mouth of the archegonium, soon one penetrated far down, followed by several others. The entrance was effected by a peculiar sinuous or spiral movement, but on account of the large size of the antherozoids, but one could pass down at a time, the diameter of the neck of the archegonium being small (Fig. 2).

The germ-cell, being buried in the tissue of the prothallium, prevented my seeing clearly the union of the antherozoids with it.—*D. H. Campbell, 91 Alfred street, Detroit, Mich.*

SISYRINCHIUM BERMUDIANA.—The following paper appeared in the April number of the London *Journal of Botany*, and is of such interest to botanists in this country that we reprint it entire:

"On first seeing the specimens of Sisyrinchium collected in the Bermudas, by Sir J. H. Lefroy and Mr. Mosely, I suspected that they were specifically different from the plant commonly

known as *Sisyrinchium bermudiana*, and after comparing them with numerous specimens of the plant so called from eastern North America, I was convinced that such was the case. Referring to the literature of the subject, I found this view supported by all the early writers who had actually seen the Bermudan plant. The history of the two species concerned is soon told. Towards the end of the seventeenth century Plukenet figured and briefly described what he termed the Bermudan and the Virginian Sisyrynchii, the types of which are still preserved in the Sloane Herbarium at the British Museum. Dillenius, who had opportunities of seeing living plants at Eltham, followed Plukenet in distinguishing these two species, and published better figures and more complete descriptions of them in the 'Hortus Elthamensis.' Linnaeus, who we assume did not see the Bermudan plant, as there is no specimen in his herbarium, united the two, as varieties of one, under the name of *S. bermudiana*. Miller, who seems to have been the most accomplished English botanist of his day, was the first to restore the two forms to specific rank. This was in 1771. In 1789 Curtis figured the true Bermudan plant and insisted upon its specific rank, remarking that he had living plants before him of both the species figured by Dillenius. Unfortunately he gave it a new specific name, for which he afterwards expressed his regret. The first DeCandolle wrote the text to the excellent figure of the Bermudan plant, which was published in Redouté's 'Liliacées,' at the beginning of the present century, and he particularly points out its distinctive characters. I have not taken the trouble to turn up every book in which the two species are likely to be mentioned, and I have not ascertained who was the first botanist to reunite them; but the North American botanists seem to be agreed that there is only one species of Sisyrinchium in the Eastern States, and this they designate *S. bermudiana*. The error probably arose in consequence of the Bermudan plant disappearing from European gardens, though the name was retained. *S. bermudiana* requires the shelter of a greenhouse in this country not merely to protect it from frost, but also to enable it to attain its full development, while *S. angustifolium*, the other species, is perfectly hardy and grows like grass. Curtis, having been deceived by its behavior during a very mild winter, at first stated that the Bermudan plant was hardy, an assertion that he recalled in the letter-press accompanying the figure cited below of his *S. gramineum*."

The synonymy of the Bermudan plant follows:—

SISYRINCHIUM BERMUDIANA Linn. Sp. Pl., ed. 1. p. 954 (quoad β tantum); Miller, Dict., ed. 6; Lamarck Encycl. Method. Bot. i., p. 408; Redouté, Lil. t. 142.

Sisyrinchium *bermudense* floribus parvis, ex cæruleo & aureo mixtis; Iris Pseudacoroides quorundam; Plukenet, Amagestum, p. 348, et Phytogr., t. 61, fig. 2.

Bermudiana Iridis folio, fibrosâ radice, Tournefort, Inst. Rei Herb., p. 388, t. 198; Dillenius, Hort. Elth., p, 48, t. 41, fig. 48.

Sisyrinchium iridioides Curtis, Bot. Mag., t. 94.

Sisyrinchium bermudianum, var. 1, Baker in Journ. Linn. Soc. Lond., xvi., p. 117.

Endemic in the Bermudas.

Besides the Bermudan specimens alluded to above, there are cultivated specimens at Kew from the herbarium of Bishop Goodenough, presented by the corporation of Carlisle.

Sisyrinchium bermudiana differs from *S. angustifolium* in being much larger in all its parts, and strikingly so in its broad leaves, which are equitant at the base; hence Curtis's name *iridioides*. It grows eighteen to twenty-four inches high, and is stout in proportion. The flowers are large, and the broad segments of the perianth are obovate-mucronate; but I have not been able to compare the flowers, as there are none of the Bermudan species in a satisfactory state. However, a comparison of the figures cited should be sufficient to convince anyone of their specific diversity.

With regard to the forms of Sisyrinchium from eastern North America, if they are all to be regarded as belonging to one species, and we have the authority of the leading botanists in the States for considering them as such, Miller's name, being the earliest, is the one to adopt.

SISYRINCHIUM ANGUSTIFOLIUM Miller, Dict., ed. 6 (1771).

Sisyrinchium anceps Cavanilles, Dissert. vi, p. 345 t. 190, fig. 2 (1788).

Sisyrinchium gramineum Curtis, Bot. Mag., t. 464 (1799).

Sisyrinchium mucronatum Michaux, Fl. Bor.-Am. ii, p. 33 (1803).

Sisyrinchium bermudiana Linn., Sp. Pl., ed. i, p. 954 excl, *β. bermudense*.

Sisyrinchium bermudiana, A. Gray Man. Bot. Northern U. S., ed. 5, p. 517; Chapman, Fl. Southern U. S., p. 474; Baker in Jour. Linn. Soc. Lond., xvi, p. 117, excl. var. 1.

Sisyrinchium cæruleum parvum gladiato caule *Virginianum*: Plukenet, Almagestum, p. 348, et Phytogr., t. 61, fig. 1.

Bermudiana graminea, flore minore cæruleo: Dillenius, Hort. Elth., p. 49, t. 41, fig. 49,

Common in the Eastern States of North America, from Massachusetts to Florida, and naturalized in the Mauritius, New Zealand, and Australia. It also occurs in Ireland, where it is reported to be spreading; and as it so readily colonizes, it has been considered as an introduced plant, though, on the other hand, the North American *Eriocaulon septangulare* is generally admitted to be indigenous in Ireland. Since the above has been in type, Dr. Asa Gray has directed my attention to the fact that Mr. Sereno Watson pointed out, as long ago as 1877 (Proc. Am. Acad. Sc., xii. p. 277), that the Bermudan Sisyrinchium was a distinct species; but as he has neither elaborated the synonymy of the species, nor explained that the Linnean *S. bermudiana* was a composite one, he has only so far anticipated me that he recognized the Bermudan plant as different from the North American.—*W. B. Hemsley.*

BAILEY'S CATALOGUE OF N. A. CARICES.—This compilation is an attempt at a complete catalogue of the North American species of Carex. It includes two hundred and ninety-three species and eighty-four varieties. It contains the latest authentic nomenclature, besides a number of reductions by the author as a result of his personal studies in the Harvard University Herbarium. For convenience of reference, the arrangement is alphabetical, and in every case the general distribution is briefly given.

In comparing it with the latest edition of Gray's Manual, the more important changes which we note are the following:

C. stellulata (No. 36 Manual)	=	*C. echinata* Murr.
C. fœnea (No. 43 Manual)	=	*C. straminea* Schk., var *chlorostachya*.
C. limula (No. 47ª Manual)	=	*C. vulgaris* Fries., var. *hyperborea*.
C. stricta (No. 51 Manual)	=	*C. angustata* Boott.
C. gynandra (No. 56 Manual)	=	*C. crinita* Lam., var. *gynandra*.
C. lanuginosa (No. 117 Manual)	=	*C. filiformis* L. var. *latifolia*.
C. paludosa (No. 123 Manual)	=	*C. acutiformis* Ehrh.
C. comosa (No. 126 Manual)	=	*C. pseudo-cyperus* L., var. *comosa*.
C. lupuliformis (No. 133 Manual)	=	*C. lupulina* Muhl., var. *polystachya*.
C. olneyi (No. 145 Manual)	=	*C. bullata* Schk.
C. rotundata (No. 149 Manual)	=	*C. miliaris* Mx.
C. pulla (No. 150 Manual)	=	*C. saxatilis* L.

C. pauciflora of the Manual (No. 4) is omitted from this catalogue.

Exchanges (and notes) in Carex, especially Western species, are solicited by the author. Copies of the catalogue may be obtained for five cents each, or in exchange for desiderata by addressing L. H. Bailey Jr., Botanic Gardens, Cambridge, Mass.

GRANT ALLEN'S COLORS OF FLOWERS.—The house of Macmillan & Co. has brought out in neat form a suggestive little book by Grant Allen, bearing the title of "The Colors of Flowers as illustrated in the British Flora." The book is an expansion of an article originally published in the *Cornhill Magazine*, and so is adapted to the wants andcapacities of the general reader. The general style of the book may be judged from the following paragraph from the introductory chapter:

"The flowers that most people observe and recognize as such are the few highly developed forms which possess large expanded colored surfaces to allure the eyes of their insect fertilizers. It is with flowers in this more popular and ordinary sense that we shall have to deal mainly in the present little treatise; and our object must be to determine, not why they are all as a group brightly colored, but why this, that, or the other particular blossom should possess this, that, or the other particular hue. Why is the buttercup yellow, while the stitchwort is white, the dog-rose pink, and the harebell blue? Why is the purple fox-glove dappled inside with lurid red spots? Why are the central florets of the daisy yellow, while the ray florets are pinky-white? Why does sky-blue

prevail among all the veronicas, while yellow predominates in the St. Johnsworts, and white in the umbellates? These are the sort of questions which we must endeavor briefly to answer by the light of modern evolutionary biology, from the point of view of the function which each color specially subserves in the economy of the particular plant which displays it."

We should like to quote more from this fascinating little book, but enough has been given to make every reader wish to possess and read the whole book for himself.

FLOWERS AND THEIR PEDIGREES.—Much like the foregoing in the mode of treatment is the somewhat larger book, "Flowers and their Pedigrees," by the same author, and brought out in this country by the New York house of Appleton & Co. The chapters take up successively the daisy's pedigree; the romance of a wayside weed; strawberries; cleavers; the origin of wheat; a mountain tulip; a family history [the order Rosaceæ]; the cuckoo-pint.

In the family history the author says: "The method of our inquiry must be a strictly genealogical one. For example, if we ask at the present day whence came our own eatable garden plums, competent botanists will tell us that they are a highly cultivated and carefully selected variety of the common sloe or blackthorn. It is true, the sloe is a small, sour, and almost uneatable fruit, the bush on which it grows is short and trunkless, and its branches are thickly covered with very sharp, stout thorns; whereas the cultivated plum is borne upon a shapely spreading tree, with no thorns, and a well marked trunk, while the fruit itself is much larger, sweeter and more brightly colored than the ancestral sloe. But these changes have easily been produced by long tillage and constant selection of the best fruiters through many ages of human agriculture. * * * * *

"Now, if we push our inquiry a step further back, we shall find that this which is true of cultivated plants in their descent from wild parent stocks, is true also of the parent stocks themselves in their descent from an earlier common ancestor. Each of them has been produced by the selective action of nature, which has favored certain individuals in the struggle for existence at the expense of others, and has thus finally resulted in the establishment of new species having peculiar points of advantage of their own, now wholly distinct from the original species whose descendants they are. Looked at in this manner, every family of plants or animals becomes a sort of puzzle for our ingenuity, as we can to some extent reconstruct the family genealogy by noting in what points the various members resemble one another, and in what points they differ among themselves. To discover the relationship of the various English members of the rose tribe to each other—their varying degrees of cousinship, or of remoter com-

munity of descent—is the object which we set before ourselves in the present paper."

The book may profitably be read by all classes of intelligent people, not excepting the scientific botanists, who at least may learn from it how to write science in simple English for non-technical readers.

North American Fungi.—Mr. Ellis delivered the 12th and 13th centuries of his now well known North American Fungi to his subscribers about the middle of April. We have repeatedly commended the successive centuries as they have appeared, and need only say that there is no sign of a falling off in their value. A notable feature of these centuries is the collection of Slime Moulds (Myxomycetes) which will be welcomed by many students.

The Flora of Buffalo.—The Buffalo Society of Natural Sciences has done a good work in issuing a catalogue of the native and naturalized plants of the city and its vicinity, compiled by David F. Day. It enumerates and gives localities for upwards of 2739 species and varieties, all of which have been detected within a radius of fifty miles. These are distributed as follows: phanerogams 1217; vascular cryptogams 53; mosses 165; liverworts 24; lichens 204; fungi 869; algæ 207.

Ensilage Mould.—Attention has been called, in England, to the various moulds found on Ensilage. In a late number of the *Gardeners' Chronicle*, Greenwood Pim describes a form which appears to have puzzled some of the British mycologists. It seems to us, from the rude drawings given, to bear considerable resemblance to the Herbarium Mould (*Eurotium herbariorum*) and indeed, it may be simply an abnormal form of that or an allied species. The great heat, in connection with the great moisture of such a mass of decaying vegetable matter, may have modified the growth, as will readily be understood by those who have attempted various cultures of moulds.

However this may be, a suggestion made by Mr. Pim is well worth the attention of our collectors. "It seems not unlikely," says he, "that vegetable matters preserved in silos may yield us some new and interesting forms of fungi, the conditions under which the fodder has been placed, being so entirely different from usual."

A Parasitic Cup-Fungus.—The habit of life of the Cup-Fungi of the genus Peziza is such, that we scarcely think of them as assuming the rôle of parasites. However, if we may credit a recent note by W. G. Smith, in the *Gardeners' Chronicle*, the abundant growth of the mycelium of *Peziza postuma* on heavily manured land became injurious to potatoes. The mycel-

ium completely exhausted all the moisture from the living stems, and reduced them to tinder, afterwards forming black masses of compacted hyphæ within the old stems. The trouble is said to have occurred last autumn in many parts of Ireland.

Red Clover in New Zealand.—We have all heard much said about red clover and humble-bees, and of the non-production of seed by the clover in New Zealand, where humble-bees are not found. It is interesting to read the testimony of Mr. J. B. Armstrong, of the Christ Church Botanic Garden, New Zealand. After an extended discussion of the subject, he says in conclusion, "I think that we may safely assume, that the following facts, in connection with the fertilization of red clover in New Zealand are proved: 1. That no clover does produce its seeds in this colony. 2. That some varieties are much more fertile than others. 3. That there is every reason to believe, that numerous individuals belonging to the species are self-fertile, and that they produce self-fertile progeny. 4. That all the varieties show a tendency to produce pale-colored flowers. 5. That the common hive-bee, and its variety, the so-called hybrid Ligurian bee, frequently gather honey from the blossoms of the red clover, thereby, no doubt, aiding cross-fertilization. There is also reason to believe that the red clover is becoming modified in its structure, so as to admit the visits of insects not known to visit it in England, and that such modification tends to render the plant self-fertilizing, but at the same time enables it to be improved in constitutional vigor by occasional inter-crossing."—*Gard. Chron., Nov. 17, 1883.*

Botanical Notes.—Dr. Vasey's report as botanist to the Department of Agriculture, as published in the report for 1883, is devoted to the grasses, of which twenty-five species are figured. It is one of the most valuable portions of the report.——A recent paper by Dr. J. T. Rothrock, in the *Am. Journal of Pharmacy* (Laboratory Contributions from the course preparatory to medicine in the University of Pennsylvania), indicates that in at least one medical school in this country there is an excellent botanical course.——The Houghton Farm Bulletin, No. 3 (series iii), just received, contains Professor Penhallow's record of orchard observations and experiments, which have a botanical as well as horticultural interest.——The catalogue of the North Carolina Exhibit at Boston [1883] contains under the head of botany and forestry a list of logs, discs and planks which were exhibited to illustrate the forest flora of the State. Among them we note especially a holly (*Ilex opaca*), 33 inches in diameter; service-berry (*Amelanchier canadensis*), 14½ inches in diameter; persimmon 24 inches in diameter, and a red mulberry (*Morus rubra*), 25 inches in diameter.——Botanists will find many rare books advertised, for sale at reasonable rates, in a catalogue of botanical works just issued by Dulau & Co., 37 Soho Square, W. London, Eng.

ENTOMOLOGY.

EATON'S MONOGRAPH OF THE MAY-FLIES, PART I.—This is a well-worked and finely-illustrated memoir, which will necessarily remain a classic. For the first time we have a thorough treatment of the generic and specific characters of this group, comprising all the known living species of the globe, the American species receiving a good share of attention, being mainly from the Hagen collection of the museum at Cambridge.

Beginning with an account of the structure of the adult insects, while we have no comparisons made with other groups of insects nor any attempt at a general morphological treatment of the subject, the reader is supplied with a judicious and reliable account of the different parts of the body, particularly the wings, the venation being discussed at length. We prefer the term "vein" to nervures, as the "veins" *are* temporarily at least blood-vessels, and have nothing in common with nerves; as the term "nervure" would suggest.

The facts stated as to the habits and mode of oviposition are fresh, and will be doubtless novel to our readers.

The popular superstition, says Mr. Eaton, that May-flies are strictly ephemeral, is fallacious in most instances. "It is true that the adult insect cannot eat, owing to atrophy of its mouth-organs and to the condition of its alimentary canal; but, provided that the air be not too dry, the imagines of many genera can live without food several days. Tradition states that Curtis kept a female Cloëon alive three weeks; this is an exceptionally long period, for in general an individual in confinement becomes perceptibly shrunken within three days, and is dead by the fourth day, if not before. Apparently there is some correspondence between the length of time spent in the subimago stage and the duration of the life of the imago; when the former amounts to twelve or twenty-four hours and upwards, the latter lasts more than a day; but when the change into imago takes place within a few minutes of the insects quitting the nymph skin, its life is fugitive, passing away in the course of the evening or early morning. In some genera of short-lived Ephemeridæ the subimago skin is partially or altogether persistent in one or the other of the sexes; and such portions of it as may be shed are moulted while the insect is in full flight." The longer-lived flies issue from the nymph-skin in a rather more matured condition than the others. The change from nymph to subimago is effected while the insect is floating at the surface of the water, buoyed up by gas which has accumulated within the alimentary canal and between the new and the old integuments of the body. The moult having been transacted in the ordinary manner, the subimago, standing upon the water with the wings erect awaits a favorable moment for flying to shelter. Fluttering steadily upwards it mounts aloft, some-

times to a considerable elevation, presently making its way to trees, walls or herbage, &c., likely to afford it a suitable resting place. Then it assumes the posture characteristic of its genus during repose. It may stand either upon all of its feet, or upon only the two hinder pairs; and the fore legs extended in advance, off the ground, may in this last case be held either close together or else apart from each other. The caudal setæ, in most instances divergent, are sometimes placed alongside of one another horizontally, or slanting upward.

The mode of flight of these graceful creatures is then described; usually, especially in the males, consisting of an intermittent action of the wings, which "results in a dance-like motion almost vertically up and down,—a fluttering swift ascent. and then a passive, leisurely fall, many times repeated." Other habits and the occasional swarming of certain May-flies are referred to, and their reproductive habits.

The facts regarding oviposition, must, we think be new to our readers. "Some short-lived species discharge the contents of their ovaries completely *en masse*, and the pair of fusiform or subcylindrical egg-clusters laid upon the water rapidly disintegrate, so as to let the egg sink broadcast upon the river-bed. The less perishable species extrude their eggs gradually, part at a time, and deposit them in one or the other of the following manners:—either the mother alights upon the water at intervals to wash off the eggs that issued from the mouth of the oviducts during her flight; or else she creeps down into the water—enclosed in a film of air, with her wings collapsed so as to overlie the abdomen in the form of an acute narrowly linear bundle, and with her setæ closed together —to lay her eggs upon the underside of stones, disposing them in rounded patches, in a single layer evenly spread, and in mutual contiguity. This has been witnessed by me several times, and in the case of several species of Baëtis. The female on the completion of her labor usually floats up to the surface of the water, ineffectively swimming with her legs, and, on emerging, her wings all at once are suddenly unfolded and erected; she then either flies away, or (as often happens) if her setæ have chanced to become wet and cannot become extricated from the water, she is detained by them until she is drowned. In some instances, however, the female dies under water beside her eggs."

The eggs are indefinitely numerous, some subrotund, others elliptical.

"Professor L. Calori (1848) and Dr. E. Joly (1877) have recorded instances of larviparition observed by them in *Cloëon dipterum*. Although they supposed that the young were produced from impregnated eggs retained within the mother, perhaps for some weeks, it may be conjectured with equal, if not greater probability, that these were the produce of unfertilized ova advanced

to maturity within the nymph and hatched as soon as she became an imago."

The young are then described; and the term nymph, since the larval and pupal stages are so much alike, is applied to all the "subaqueous stages in the development of the young after it is hatched." They mostly feed upon either mud or minute aquatic vegetation, such as covers stones and the larger plants; but (judging by their mandibles and maxillæ) some must be predaceous. The nymph of Palingenia is said to remain such one year.

The character and peculiarities of the nymph are given in great detail; while the means of distinguishing the subimago from the adult are stated. After a history of the classification of the Ephemeridæ, the bulk of the memoir is devoted to the systematic description of the genera and species. The illustrations are noteworthy from the attention given to the venation of the wings and other details, which, of course, add vastly to the value and permanency of the work; twenty-four plates being filled with the sketches, which are drawn upon a large scale.

NOTES ON MOTHS.—We have long had a specimen of the very rare *Sphinx elsa* Strecker, from Salt Lake City, Utah, given us by Mr. J. L. Barfoot, curator of the Salt Lake museum. It was originally described by Strecker from Arizona, and is well figured in his "Lepidoptera, indigenous and exotic." Like other moths from the Great Basin this has a peculiarly faded and bleached appearance, probably resulting from the light soil and bright skies of Utah and adjoining territories.

Smerinthus imperator Strecker occurred in a collection of moths from Reno, Nevada, presented to us in 1877 by Rev. C. H. Pope. It agrees well with Strecker's figure, and is undoubtedly the same as the Arizona form; but until we have a suite of specimens of the Eastern *S. modestus* and the Western var. *occidentalis* H. Edw. from the Pacific coast for comparison, it will be difficult to decide whether it is specifically distinct from *S. modestus* of the Atlantic coast.

The following faunal notes on Bombycidæ may prove of interest: *Stenopis argenteomaculatus* Harris, was taken by us at twilight in Gilead, Maine, in July. The second outer triangular silvery spot is obsolete; but the specimen agrees with Harris' figure in the style of marking. *Stenopis argentata* Pack., has been taken twice in Providence, in 1883, in June. One example belonging to Mr. G. E. Gray lacks the second outer silvery spot.

From Mr. J. L. Barfoot, of Salt Lake City, we have received *Pyrrharctia isabella;* from Dr. Palmer, in Southern Utah, and from Mr. Siler, of Ranch, Utah, specimens of very white bleached *Pseudohazis hera*, showing the same climatic effects as wrought

upon *Sphynx elsa*, *Euleucophæus gloverii*, *Gloveria arizonensis*, etc. In *P. hera* the discal dots are linear. *Epicallia virginalis* var. *ochracea* has been sent us from Southern Utah.

In Colorado we collected several years ago *Arctia achaia* Grote, Idaho Springs, July 6th; and with it occurred *Leucarctia permaculata* Pack. *Lycomorpha palmerii* was not infrequent at Manitou, July 16th; it was originally described by us from Southern California. In South Park Colorado, occurred *Tolype velleda*.

The localities of the following Geometrids are new: *Dasyfidonia avunculuria* (Guen.) Reno, Nevada; and in the same collection *Marmopteryx marmorata;* from Colorado (Scudder) *Selidosema inturnaria;* the same, var. *californiaria*, from Beaver Mts., Utah (Palmer in Scudder's collection).—*A. S. Packard, Jr.*

The Bird-louse (*Dermaleichus pici-pubescentis*).—In November, 1883, I found this interesting mite, first described by Professor Packard as occuring on *Picus pubescens*, on a specimen of the hairy woodpecker (*P. villosus*). They were especially numerous on the barbules of the feathers at the upper part of the throat, although they were also found on the feathers situated on the under side of the wings.

Besides the forms described by Professor Packard (see "Guide to Study of Insects"), there was another form, which is probably the hexapodous stage of the female, which has not yet been described.—*Clarence M. Weed.*

Entomological Notes.—The transactions of the tenth volume of the American Entomological Society, parts 3 and 4, contain most excellent matter: such as Lord Walsingham's notes on Tineidæ of North America; Mr. John B. Smith's synopsis of the North American Heliothinæ; Dr. Horn's miscellaneous notes and short studies of North American Coleoptera.——Dr. Williston publishes in the eleventh volume of the transactions of this society, a paper on the North American Asildæ, with a description of a new genus of Syrphidæ, with two plates.——Bulletin No. 3, U. S. Department of Agriculture, division of Entomology, comprises reports of observations and experiments in the practical work of the division, made under the direction of the entomologist, Professor C. V. Riley. It contains notes on the army worm, and experiments with pyrethrum, by C. V. Riley; notes on forest tree insects, by A. S. Packard, Jr. (containing descriptions of the transformations of *Eupithecia luteata*, *Caripeta angustioraria* and *Cryptolechia schlagenella*); a report upon the cotton worm in South Texas in the spring and early summer of 1883, by E. H. Anderson; experimental tests of machinery designed for the destruction of the cotton worm, by W. S. Barnard. The most important paper, and one of the best monographic accounts of an interesting group of moths which has appeared in this country, is Dr. James A. Bailey's "Some of the North American Cossidæ, with facts

in the life-history of *Cossus centerensis* Lintner," containing excellent biological matter, and illustrated by two well-engraved plates. The publication of this Bulletin marks a new era in the work and development of the entomological division of the agricultural department, and we hope the publication will be well sustained.——*Psyche*, vol. III, Sept.–Oct., 1882 (issued late in 1883), contains a noteworthy paper by Dr. Geo. Dimmock, on some glands which open externally on insects. Vol. IV, Nos. 115-116 contains Mr. Lintner's "New sexual character in the pupæ of some lepidoptera;" a very just tribute to the memory of J. L. LeConte, by C. V. Riley; the gills of insect larvæ, by G. McCloskie; the screw worm-fly (*Compsomyia macellaria*), by S. W. Williston.——The oldest Tracheates known are probably two fossil myriopods from the Lower Old Red Sandstone (Devonian) of Scotland, described by B. N. Peach in Proceedings Royal Physical Society of Edinburgh, 1881-82.

ZOÖLOGY.

Occurrence of Chlorophyll in Animals.—C. A. MacMunn bases his conclusions as to the identity of animal and vegetable chlorophyll on the fact that the wave-lengths of centers of the bands of the same solutions of animal and vegetable chlorophyll are the same, and that the wave-lengths of the centers of the bands are the same when the same reagent is added to the respective solutions. Without committing himself to accepting the views of Kraus or Sorby, he applies the term chlorophyll to that coloring matter or mixture of coloring matters, which can be extracted out of green leaves, such as those of Primula, by means of alcohol, or alcohol and ether. The coloring matter, to which the writer has given the name "enterochlorophyll," and which can be extracted from the liver or other appendage of the enteron of invertebrates, was shown to be probably produced by, and in, the body of the animal, and not food chlorophyll. The absence of parasitic algæ in sections of the livers of certain mollusks which yield entero-chlorophyll, shows that this pigment cannot be due to their presence. The writer further showed that Pocklington's observations, published in the *Pharmaceutical Journal* in 1872, on the presence of chlorophyll in the wing-cases of Cantharides beetles would be verified, and he had succeeded not only in verifying the presence of the principal chlorophyll band in the ether, chloroform, and alcohol solutions of the wing-cases; but the changes produced in the spectra of these solutions on the addition of certain reagents showed the presence of a body indistinguishable from vegetable chlorophyll. Hence, Leydig's conclusion as to the presence of that coloring matter in insects was proved to be correct. However, in the case of green larvæ the occurrence of a band in the red when a strong light is concentrated on the integument may be merely due to the presence of food chlorophyll

in the intestine, for, on squeezing out the contents of the latter, the green color and the band both disappear. It was then shown that chlorophyll could hardly be of much use in respiration, as oxydizing and reducing agents do not affect it; that for protective purposes or in mimicry a body of less complex chemical composition might answer equally well, except that the eyes of some invertebrates may be more susceptible to rays of light of a certain wave-length than our own, especially as Sir John Lubbock has shown that ants perceive the ultra violet rays of the spectrum which are invisible to us. It may possibly be the persistence of a pigment which was once useful in a remote ancestor in some cases, perhaps at a time when the atmosphere contained much more carbon dioxide than at present. Or, again, it may be of use in absorbing the chemically active rays of the spectrum when occurring on the surface of an animal, especially as Zimiriazeff had shown that Langley's observations with the bolometer have proved that the point of maximum energy of the solar spectrum corresponds with the principal chlorophyll band between B and C. In the case of enterochlorophyll this coloring matter may be of use in furnishing material for the construction of other coloring matters, especially as this body and Læmochromogen exist side by side in the bile of some mollusks; and in the bile of the sheep and ox a body exists which fluoresces red and resembles chlorophyll closely, but possesses at the same time some properties that show that it is a hæmoglobin derivative, as proved by the writer. The conclusions which have been arrived at gave support to the view which Professor Lankester has maintained, namely, that chlorophyll may occur quite independently of the presence of parasitic algæ, as in Spongilla and Hydra, and that it is in some cases produced synthetically by and in the bodies of animals.—*Journal of the Royal Microscopical Society, December, 1883.*

Vital Manifestations of the Sponges.—Taking the sponges as an example of a group in which tissues, organs and physiological divisions of labor are almost entirely absent, B. Solger makes them the starting-point in his proposed study of vital manifestations and their increasing complication in the animal kingdom. He gives a summary of facts deduced from observations by various writers.

The functions of *the endodermal ciliated chambers and cells* appear to be respiration and the prehension of nutriment, recent researches seeming to deny them the—at any rate the exclusive—power of actual digestion. The mesoderm probably shares in the latter function; the claim of the ectoderm to this position is less indisputable. The occasional occurrence of lipostry and lipogastry does not affect this question much, but relates chiefly to the manner of disposing of the used-up water. The function of exhalation is transferred in lipostomy to other canals and

pores; that of digestion in lipogastry is taken up by the ciliated chambers, or possibly by the ectoderm and mesoderm. The discovery of digestive ferments (pepsin, trypsin) in the body of the sponge has its importance somewhat reduced by the uncertainty which prevails as to the exact distribution of these compounds in the living animal. A reserve of nutriment occurs at certain times in several widely distinct sponges, and in some cases starch has been demonstrated between the cells, but there appears reason to regard this as derived from algæ. Oily matters have been extracted by chemical processes from sundry sponges, and traces of fatty matter have been observed. Though so commonly found dissolved in fatty matters in vertebrata, coloring matters are found abundantly in the sponges, although fats are so scanty in these organisms. They occur in the endodermal ciliated cells (*Spongilla avara*, Calcisponges) or in the mesoderm (*Euspongia officinalis*, Chondrosa). Some forms (Calcarea), from being colorless, take a brown color when placed in spirit; others (Suberites, Hircinia, and Stelletta, spp.) lose their color if exposed to the light. *Aplysina aerophoba* offers a remarkable example of change of color consequent on death, viz., from a sulphur-yellow to Prussian blue. This is caused by changes in certain roundish, refractive, mesodermal cells, with bladder-like nucleus, and small surrounding granular space. The color is preserved unchanged in solution of salicylic acid. The substance which produces it is considered to be reserve nutriment. The same body (aplysinofulvin) appears to occur in Aplysilla sp. and Hircinia sp., but changes much less rapidly in Aplysilla than in Aplysina, perhaps because the reducing ferment which hinders its conversion is decomposed more slowly in the latter case. The *horny fibers* have been shown to be excreted from special mesodermal cells. No proofs have yet been given of the occurrence of a moulding of the sponge-skeleton by absorption, such as the plasticity of such forms as *Ascetta elathrus* would seem to suggest. In connection with the rearing of sponges, it is remarked that Cavolin's observation that, after having taken root, the pieces of sponge shed over the old parts a mucilaginous mass, in which the skeleton subsequently appeared, might be utilized as giving a hint where to look for the youngest parts, when these are sought after, and thus further the study of tissue-development.—*Journal of Royal Microscopical Society, December, 1883.*

Pedal Glands of Mollusca.—J. Carriére thinks that the openings in the feet of Gasteropods or Lamellibranchs are the orifices of various glands; water does not seem to be taken into the blood directly either by their pores or by the kidney; nor is a quantity of water necessary for the erection of the foot, for the blood alone can bring that about. The renal cleft is not used as the means for introducing water into the blood, but rather as a

passage by means of which the fluid which passes into the pericardium from the blood can make its way into the kidneys. There are no indications of a water-vascular system in either Gasteropods or Lamellibranchs. In pursuing his investigations the author found great assistance from the air-pump, the use of which he learned at the Naples station. The thickest and largest pieces of the feet, which would otherwise have required several day's treatment, were rendered easy of section after a few hours. —*Journal of the Royal Microscopical Society.*

Suckers of Cephalopods.—P. Girod describes the suckers of *Octopus vulgaris* and *Sepia officinalis*, which are at first to be distinguished from one another by their sessile condition in the former and their pedunculated character in the latter; in the Decapod there is, further, a horny ring developed, but there is not, as in the Octopod, any elastic cup or construction, the cavity of the sucker forming a single chamber.

In the Octopod the suckers act thus: The animal contracts the extrinsic infundibular muscles, the sphincter of the orifice, and the inferior muscular envelope, and the form of the sucker becomes perfectly plane. Then the infundibulum or upper portion of the sucker becomes conical, the acetabular chamber enlarges, and its orifice dilates slightly; a vacuum is thus formed, and any pulling on the sucker only tends to separate the orifice from the base of the sucker, and so to increase the vacuum. In the Decapod there is a piston-like arrangement which becomes withdrawn by the action of lateral muscles, while the horny ring becomes more firmly attached. As the author justly points out, his results will be more completely displayed when he gives an account of the minute structure of the parts which he here mentions.

Researches on the Isopoda.—L. Huet, among the important additions which he has made to our knowledge of these Crustacea, has been able to prove the existence of large salivary glands, and that not only in the terrestrial, but also in the groups that are essentially marine, such as the Idoteidæ and the Cymothoidæ. This discovery is of especial importance when we remember that, with but rare exceptions, these glands are only found in land forms. On the other hand, we must remember that in certain Decapod crustaceans, small, glandular masses, which have given some indications of being salivary in character, have been already observed. Indeed, the author thinks himself justified in extending to the whole group the results which he has found true for the Isopoda.

With regard to the processes of respiration, the author made a number of experiments which resulted in showing him that, though there is a very close resemblance in the characters of the organs by which they are effected, there are but few found that can, without danger, exchange a terrestrial for an aquatic mode

of life, or *vice versâ*. Of such we have an example in Ligia, but here, as in all, the air respired must be damp.

Especial attention may be given to the sympathetic nervous system, the arrangement of which is as yet only incompletely known. It is much more complex than that of the Decapoda and the splanchnic system appears to be analogous to that of the recurrent intestinal nerves of Limulus, arising, as the nerves do, from the hindermost of the nerves of the body. On the other hand, there is a close resemblance between the minute structure of the nervous system of the Isopoda and the Decapoda.

Lereboullet has already pointed out that the silky secretion formed by the cutaneous glands of certain terrestial forms presents a character in which they approach the Arachnida; and M Milne-Edwards has regarded the so-called white bodies of the opercular gills as rudiments of a tracheal system. By their external form, some Isopods, as, for example, Armadillo, approach such myriopods as Glomeris; and, taking them on the whole, the Isopoda present a certain number of intermediate characters, by which they may be justly brought into association with various other groups of arthropods, and which, at least, give them a very special position among the Crustacea.—*Journal of the Royal Microscopical Society, December, 1883.*

Commensalism between a Fish and a Medusa.—In a consignment from the Mauritius, G. Lunel found united *Caranx melampygus* and *Crambessa palmipes*. The fish stuck with the greater part of its body in the apertures which are formed by the four columns uniting the stomach with the nectocalyx, and traversed by the gastro-vascular canals. This union could not be explained by the hypothesis that the animal had sought out the other as its prey and means of nourishment; for the medusa belongs to a family which possesses no proper oral aperture, but only a series of microscopic pores, which can only take in very finely-divided nourishment, and the fish had merely taken up his quarters in a natural hollow of the medusa, which was only enlarged, but in no way injured, by the long residence of the fish.

It was ascertained that the fisherman had taken the two animals together in that position, and that several years ago there had been seen on the coast, in a depth of about six inches below the surface, a fish of the same kind in conjunction with an anemone, and going in and out of it. The anemone into which the fish had entered was living, for it could be seen moving.

Lunel arrives at the conclusion that there are certain kinds of fish, the fully grown individuals of which live at more or less considerable depths; whilst the young, either on account of an unknown peculiarity of their organization, or because they require a diet more congenial to their age, ascend with particular medusæ to the upper regions of the sea, to find there the countless small

pelagic animals on which they and their hosts are nourished. It is noticeable that the fish, in order to enter the medusa, must swim upon its side, therefore in a very abnormal position.—*Journ. Roy. Microscopical Society.*

Snakes in Nebraska.—Miss C. C. Hopley writes thus in the *London Field:* From Nebraska a writer says that the number of snakes killed during the late overflow (July) of the Nemaha river is beyond belief. It is estimated that more than 3000 were killed near Falls City that had been driven by the water to the higher ground. They were chiefly Eutæniæ and Tropidonotus, with a few rattlesnakes. The writer, who had long been a resident of the locality, and who knew the country well, was "amazed" at the number of reptiles, and where they could have previously hidden themselves, as the overflowed district did not average a mile in width, and he had thought it sparse in snakes. One curious and comfortable retreat was in the long hair of a horse's mane. The animal had been confined in a pasture in the flooded district, and when released, several snakes were found thus hidden, and apparently tolerated.

The Pelvisternum of Edentates.—M. P. Albrecht notes the presence, between the pubes of certain Edentates, of elements which he believes to be pelvisternal. In *Manis pentadactyla* two small bones, cartilaginously united to each other and to the pubes, separate the latter; in *Dasypus sexcinctus* and *Cholœpus didactylus* a single bone exists; in *Bradypus cuculliger* this single bone has attained a comparatively large size; in a *B. tridactylus* examined, the bony pelvisternum was soldered continuously with the pubes, with traces of the union on one side; while in many Edentates the pubes are united by a continuous bony bar, without a trace of the junction. M. Albrecht believes that these facts show the order of evolution of this part of the pelvis of the Edentata, and that the paired ossifications in question represent a *sternum* of the posterior extremities formed of a single sternebra. The evolution of this bone is parallel with that of the body of the hyoid in Mammalia, and though it appears to be placed between a pair of elements only, instead of mid-way between two pairs, as is the case with the hyoid body, this difference disappears upon examination of the state of things in the Batrachia and Lacertilia. These have an ischio-pubic symphysis, and the symphysial cartilage seems to be homologous with the pair of small bones found in the Edentates. This pelvic sternebra finds, in the anterior limb, its homodynamic representative in the paired element which unites the precoracoid with the coracoid, that is, in the epicoracoids. For these corresponding parts of the anterior and posterior sternums, M. Albrecht proposes the names of *omosternum* and *pelvisternum.* In front of the cartilaginous pelvisternum of the salamander is a Y-shaped cartilage, which Albrecht homologizes with the epi-

pubic cartilage of Lacertilia and with the marsupial bones of the Mammalia, and believes to be homodynamic with the episternum (Wiedersheim) of the Anura and the pair of substernal bones found at the anterior extremity of the sternum of some mammals and even in man. These elements are, therefore, styled by M. Albrecht *pre-omosternum* and *pre-pelvisternum* respectively. The element existing behind the pelvisternum in the Lacertilia is similarly styled *post-pelvisternum*, while the *xiphisternum* of the Anura is the *post-omosternum*. These parts are considered by M. Albrecht to be formed by the ventral parts of the limb bones, and thus are not homologous with any part of the *costosternum*, which is composed of copulæ that link together the ribs.

The pelvisternum of the Mammalia had been noticed by two or three authors prior to M. Albrecht's paper.

Scales, Feathers and Hairs.—The idea current among naturalists generally, and largely taught to students, that scales, feathers and hairs are identical in nature, is combatted by Mr. J. E. Jeffries in a recent issue of the Proceedings of the Boston Society of Natural History. Mr. Jeffries considers the epiderm to be the primitive skin, if not the true one, as it is formed long before the corium, which is a late and very variable product of the mesoblast; and because all the organs of sense are formed from it. The epiderm may be regarded as primitively consisting of a smooth mucous layer, an epitrichial layer, and perhaps an intermediate layer of parenchymatous cells. In birds and mammals the outer layer is lost, and never renewed, while the middle layer becomes thickened and subject to various modifications, as drying, conversion into horn, etc., and enters into the structure of all the appendages. Scales are molted and renewed, scuta are not. The toe-pads of birds may be seen to pass over into scuta on the sides of the toes of many birds. Scuta bear feathers as epidermal appendages—scales never do, thus pointing to scuta, which have a mucous layer and outer horn coat with a mesodermal core, as simple folds of the skin, not as appendages.

The early stages of a feather and of a hair differ. The latter is formed *in a solid* ingrowth of the epiderm, the latter from the epiderm of a large papilla. A hair does not contain any of the mucous cells, while a considerable portion of a feather consists of them. The supposed homology between feathers and scales seems to fail before the facts that the mucous layer is absent in the latter, and that Studer has shown that the imagined scale-like nature of the remiges of penguins is a fallacy. Mr. Jeffries avows his belief in the distinct origin of the dermal appendages of the higher vertebrates, and asserts that the nakedness of the Amphibia is a strong argument against the identity of any of the avian appendages with those of reptiles or mammals.

DR. COUES' RENUMERATION OF THE SPINAL NERVES.—The suggestion contained in Dr. Coues' article in the last number of the NATURALIST promises to relieve the student of human anatomy of certain difficulties in connection with the spinal nerves and plexuses. More important considerations will, however, deter comparative anatomists from adopting the suggestion.

The renumeration goes upon the principle that a spinal nerve is a strictly "intervertebral" structure, and that it is indifferent whether we associate it with the vertebra in front or that behind it. Such is, however, not the case. Each spinal nerve belongs to a particular vertebral segment of the body, that through whose neural arch or behind whose neural arch it issues, and ought to be named after that segment. There are many of the lower mammalia, Monotremata, Bruta, Ungulata, in which the spinal nerves perforate the neural arches of the segment to which they belong instead of issuing behind them. Thus the first dorsal nerve of a horse perforates the neural arch of the first dorsal vertebra. If we adopt Dr. Coues' nomenclature, we should have to say that the second dorsal nerve perforates the neural arch of the first dorsal vertebra—as unhappy an expression as any caused by reckoning eight pairs of cervical nerves.

In this respect the older nomenclature was less objectionable, for there the first spinal nerve was described as "suboccipital;" the second as first cervical, the eighth as seventh cervical, the ninth as first dorsal, &c., to the vertebral segments bearing which names the nerves really belong.

It is unnecessary to dwell longer on the above line of argument, for it has been fully elucidated by Dr. Albrecht (Zoölogischer Anzeiger, vol. III, 450 and 472), who regards the suboccipital nerve as the sole remnant of a *proatlantic* vertebral segment, traces of the osseous elements of which he finds in front of the atlas in the alligator and hedgehog. Whether Albrecht's proatlas be accepted by anatomists, or whether it be more probable that the segment to which the suboccipital nerve belongs has been swallowed up in the occipital region of the skull, does not affect the basis of his contention that a spinal nerve belongs to that vertebral segment through or behind whose neural arch it issues.

Of interest in this connection is Sagemehl's discovery of three rudimentary occipital nerves (with corresponding osseous elements) between the vagus and the first spinal nerve in Amia (Morph. Jahrb. ix, 190). Sagemehl concludes that all Teleostei must have originally possessed occipital arches. If what Sagemehl describes as the first spinal nerve of Amia is really homologous with the nerve of the same name in Teleostei, it is singular that no traces of the occipital nerves have been found in the latter unless, indeed, we are to assume that they have disappeared in the vagus.—*R. Ramsay Wright, University College, Toronto.*

ZOOLOGICAL NOTES.—*Protozoans.*—Kunstler describes *Trichomonas vaginalis* as extremely protean in external form. Pseudopodia arise over the general surface, or are localized at the posterior end.——G. Klebs discusses (*Bot. Zeitung*, 1883), the relationship of the Flagellata to the Algæ and Infusoria. Some Flagellata in the older sense are referred to the lower chlorophyllaceous Algæ; such are, in addition to the Volvocinæ, the Chlamydomonads. The fresh-water forms of the Peridineæ are, with Leuckart, regarded as plants. The Euglenaceæ and Peranemeæ are separated from the Ciliata and placed among the Infusoria.

Crustaceans.—A remarkable shrimp (*Nematocarcinus gracilipes*) was dredged by the *Talisman* at a depth of 850 meters, which is analogous to certain blind cave phalangids in the enormous length and slenderness of the antennæ and legs. The eyes are large and well developed, though the stalks are short. In a new form (*Acanthephyra pellucida*) the feet are adorned with phosphorescent bands.

Mammals.—Miklucho Maclay finds that the average temperature of the body of *Echidna hystrix* is 78° F., or very little more than that of fish, and about 25° less than mammals generally.—— So far as known, congenital deafness is only known to exist besides man in the cat, and always in white ones, and most usually in females.

PHYSIOLOGY.[1]

THE PHYSIOLOGY OF THE CARBOHYDRATES.—In the London *Lancet* of Januury and February, 1884, Dr. Pavy records some interesting experiments which prove the presence in the stomach and intestines of animal ferments which have been hitherto unknown. Dr. Pavy's general object was to discover the history of carbohydrates in the animal system:

1. Solutions of grape sugar placed in contact with the mucous membrane of the stomach or intestine of a recently killed rabbit become changed into a carbohydrate which has less power of reducing Fehling's solution than grape sugar. Boiling the mucous membrane destroys its power of acting on glucose. This power of the mucous membrane is due to a ferment which is contained within the glands of the stomach and intestine, but is not secreted by the superficial epithelium covering the walls. The action of the ferment was gradual and progressed better at the temperature of the body than at lower temperatures. The ferment was not destroyed by drying and can be preserved when the mucous membrane is brought into this condition. In ruminant animals the ferment is not found in the true or fourth stomach, which corresponds to the single stomach of other animals, but in the three anterior chambers of the quadruplex organ.

2. The stomach and intestine are shown also to yield a ferment

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

which has the power of converting cane sugar into a carbohydrate which reduces Fehling's solution, but does so less completely than grape sugar; this product, as well as that previously described, has about the same reducing power as maltose. The stomach in animals generally contains much less of the cane sugar ferment than the intestine. This ferment appears to be contained not in the glands of the mucous membrane, but in the superficial epithelium of that coat. (It may be remarked that the cane-sugar-converting power of the mucus secreted by the lining epithelium of the stomach has long been known.)

3. This conversion of cane sugar into a maltose-like body occurs under physiological conditions, for when cane sugar is injected into the stomach of a living animal, if the portal blood be examined twenty or thirty minutes afterward, it is found to contain no cane sugar, but a carbohydrate like that produced from it by the action of the ferment already described.

Human Physiology, by Henry Power, F. R. C. S.—This is an excellent little book of its kind, but the kind is very poor. The work contains statements of a great number of physiological facts condensed within a small space, and will therefore be welcomed by the student who is cramming for an examination. But the teacher-physiologist who satisfies himself with the bare mention of facts, allows his subject to lose its chief importance as a discipline to the reasoning powers, and is liable to eventually miss his aim altogether, for isolated facts are with difficulty remembered when not strongly bound together into chains of cause and effect.

The Fibrin-ferment.—It is a question of considerable interest as to whether those peculiar bodies known as animal ferments, such as *ptyalin*, *pepsin*, *trypsin*, etc., are proteid substances, or whether they are of simpler chemical composition. Messrs. Lea and Green have recently investigated the so-called fibrin-ferment which induces coagulation in drawn blood, and they find that while it seems impossible to obtain the ferment in a solution which is quite free from proteid reaction, still this can be so nearly accomplished that there is little doubt that the ferment is a non-proteid body. The fibrin-ferment is best prepared by diluting fresh blood with 10—15 times its volume of water, and after the mixture has stood twenty-four hours, washing the clot until it is colorless; the clot is then pressed, rinsed and extracted in the cold for two days in 8 p. c. sodic chloride. This extract produces rapid coagulation of diluted blood plasma, and it may be nearly completely freed from proteids if a large amount of strong alcohol be added; a watery extract made from the precipitate thus formed will have marked ferment action.—*Journal of Physiology, vol. iv., No. 6.*

PSYCHOLOGY.

THE PRACTICAL TYPES OF MIND.—Men may be divided into three classes with reference to the practical use they make of their intellectual powers, which use is generally an indication of the type of intellect which they possess. These types are the mercantile, the literary and the scientific.

The first is occupied in accumulating material possessions which often involves the deprivation of other people of theirs. Their reasoning powers are much occupied in calculating values and in scheming to get control of the sources of physical power. It is a necessary outcome of the struggle for existence and is best developed in those whose struggles are most recent. This is a good training school, but a bad state to be permanent.

The literary mind deals largely with the *manner* of things, while the other two minds deal with the *matter*. Its field is with the beauties and refinements of life, and by sugar-coating the severities, performs great service in our education. Symbols are its instruments, and these it is prone to mistake for things.

The scientific mind occupies itself with realities, and finds chief value in the truth. This it seeks for and sets forth at all hazards. It finds its pleasure in mental rather than material possessions and counts its wealth in ideas. It differs from the mercantile mind in this, that it gives away its commodity for the benefit of others, while the mercantile sells to the highest bidder.

Sometimes two or more types of mind are combined in the same person, which may be a fortunate conjunction.—*E. D. Cope.*

CURIOUS COMPANIONSHIP OF THE COYOTE AND BADGER.—I have occasionally heard "cow boys" and others in Wyoming Territory speak of the existence of intimate social relations between the coyote (*Canis latrans*) and the badger (*Taxidea americana*). They report that the former not only travels in company with the latter, but often feeds and protects him. Up to the summer of 1883, I regarded these statements as the fruit of fertile imaginations, and as having no basis in fact. Observation, however, has compelled me to believe that intimate relations at least occasionally exist between these animals. During the last summer I had the good fortune to see the coyote in company with the badger on three different occasions, and once under peculiar circumstances. I was engaged in making geological observations about fifteen miles east of the Beaver river, in Wyoming Territory, in a region of Miocene Tertiary bad lands. Sitting on a low butte examining some fossils, I saw, several hundred feet below me, a coyote and badger walking together, and every few minutes stopping and playing. The coyote would go in front of the badger, lay its head on the latter's neck, lick it, jump into the air, and give other expressions of unmistakable joy. Its antics with the badger were very much like that of a young dog playing with

another pup, or when meeting its master. The badger seemed equally well pleased. This playing and fondling of each other was kept up for over half an hour, and until they disappeared around the end of a butte near by. Again, during the month of March, when camped near the intersection of the Bridger road with the overland trail, a still more curious example of this companionship occurred. At early dawn I observed a coyote close to a pile of specimens, about 200 yards from my tent. The following night I placed some meat on this pile and the coyote "went for it," about the same time in the morning. I repeated this experiment, as my object was to observe more closely its habits, and especially to ascertain how tame it might be made by decent treatment. To my surprise, on the fourth morning the coyote was accompanied by a badger. The following morning the coyote came alone, but on the morning after that the badger again came along. After that neither coyote nor badger made their appearance, but why they abandoned my hospitable quarters is a mystery to me. In these instances the coyote carried off the breakfast that I had provided, and I could not tell whether or not it was shared with the badger. It, however, became evident to me that these animals do not associate by accident; they must have some affinity for each other, or else they would not thus come together.

The coyote is naturally sociable. Often when I have encountered him amid the wilds of nature he stood and gazed after me wistfully, as if he meant to say, "I wish I could have your company." He soon learns to know that man is his enemy, and for his own preservation gives him a wide berth.

It is not at all improbable that future investigation may show this fellowship to be a case of symbiosis. It is hoped that this will call out others who have had more extended opportunities to observe the habits of these animals. One of the first from whom I learned of this intimacy between the coyote and badger was W. C. Hoftile, of Lander, Wyoming Territory.—*Samuel Aughey.*

ANTHROPOLOGY.[1]

The Astor Library.—The thirty-fifth annual report of the Astor Library, for 1883, affords some information upon the popularity of anthropological studies. In the department of science and art there were 76,573 volumes called for; of these, 105 were upon anthropology; 783 upon archæology; 119 upon ethnology; 226 upon mythology, and 1020 upon social science. In the common acceptation, however, social science means more than it does in the anthropological sense. The latter includes only those works in which the rigid methods of natural history are applied to society. The former includes every speculation on the natural ills that flesh is heir to. In the department of history and literature the number of volumes called for was 89,824. Of these, 184

[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

were upon chronology; 4559 upon heraldry and genealogy; 214 upon the history of American Indians; 739 upon oriental literature; 863 upon manners and customs; 717 upon Orientalia; 4[illegible] upon philology and linguistics. Doubtless many other volumes were drawn for anthropological research, for instance, those on war, biology, domestic economy, ethics, geography, history, travels, etc.

THE BRITISH ASSOCIATION ANTHROPOMETRIC COMMITTEE.—In 1875 the British Association appointed a committee on anthropometry, of which Dr. William Far was chairman until 1878. The reports of the committee are as follows: 1878, 5 p., Annual Rep. 182–6; 1879, 35 p., *ibid.* 175–209; 1880, 41 p., *ibid.* 120–15[illegible]; 1881, 48 p., *ibid.* 225–272; 1882, 3 p., *ibid.* 278–280; 1883, final report, 54 p., separate. The points to which inquiries were addressed are: 1. Stature; 2. Weight; 3. Chest-girth; 4. Color of eyes; 5. Color of hair; 6. Breathing capacity; 7. Strength of arm; 8. Sight; 9. Span of arms; 10. Size and shape of head; 11. Lower limbs; 12. Measures of other parts of the body. These measures were applied to the different elements of the mixed population of Great Britain and compared with those of other parts of the world. The results are partly shown in the following table:

Race or Nationality.		*Authority.*	*Meters.*	*F. In.*
Polynesian	Samoa 1.853	La Perouse	1.762	5 [illegible]
	Tahiti & Pitcairn 1.782	Garnot, Beechey		
	Marquesas 1.763	Porter, Cook, &c.		
	New Zealand 1.755	Various		
	Polynesians 1.753	Wilkes, Novara		
	Sandwich 1.731	Lesson, Rollin		
English professional class		Anthrop. Com.	1.757	5 [illegible]
Patagonians	1.778	Musters	1.754	5 [illegible]
	1.730	D'Orbigny		
Angamis (Naga hills)		Woodthorp	1.754	5 [illegible]
Negroes (Congo)		Topinard	1.752	5 [illegible]
Scotch		Anthrop. Com.	1.746	5 [illegible]
Amakosa Kaffirs		Sir A. Smith	1.741	5 [illegible]
Iroquois Indians		Gould	1.735	5 [illegible]
Todas (Nilghiries)		Marshall	1.727	5 7.05
Negroes (Calabar)		Topinard	1.727	5 [illegible]
N. A. Indians		Baxter	1.726	5 [illegible]
Irish		Anthrop. Com.	1.725	5 7.00
U. S. Whites		Baxter	1.719	5 [illegible]
English		Anthrop. Com.	1.719	5 7.00
Norwegians	1.727	Beddoe	1.719	5 [illegible]
" immigrants U. S.	1.717	Baxter	1.707	5 [illegible]
Zulus		Roberts	1.705	5 [illegible]
English laborers		Anthrop. Com.	1.703	5 [illegible]
Canadians, U. S., French immigrants		Baxter	1.705	5 [illegible]
Tajiks of Feyhana & Samarkand		Ujfalvy	1.700	5 [illegible]
Swedes, U. S., immigrants		Baxter, Beddoe	1.700	5 [illegible]
Chippeway Indians		Oliver	1.699	5 [illegible]
Kabyles		Topinard	1.695	5 [illegible]
Welsh		Anthrop. Com.	1.694	5 [illegible]
Danes, U. S., immigrants		Baxter	1.693	5 [illegible]
Dutch, " "		Baxter	1.693	5 [illegible]
American Negroes		Baxter		

Race or Nationality.	*Authority.*	*Meters.*	*Ft. In.*
English, U. S., immigrants	Baxter	1.692	5 6.58
Hungarians	Baxter	1.692	5 6.58
English Jews	Anthrop. Com.	1.692	5 6.57
Germans, U. S., immigrants	Baxter	1.691	5 6.54
Swiss of Geneva	Dunant	1.688	5 6.43
Swiss, U. S., immigrants	Baxter	1.687	5 6.38
Russians, " "	Baxter	1.687	5 6.38
Belgians	Quetelet	1.687	5 6.38
French, U. S., immigrants	Baxter	1.683	5 6.23
Poles " "	Baxter	1.682	5 6.20
French upper classes	De Quatrefages	1.681	5 6.14
Germans	Novara	1.680	5 6.10
Mexicans	Baxter	1.680	5 6.10
Berbers of Algeria	Topinard	1.680	5 6.10
Arabs	Various	1.679	5 6.08
Usbeks of Ferghana & Samarkand	Ujfalvy	1.679	5 6.08
Javanese	Novara	1.679	5 6.08
Persians	Shulz	1.678	5 6.04
Italians, U. S., immigrants	Baxter	1.677	5 6.00
South American "	Baxter	1.675	5 5.90
Australians (aborig.)	Various	1.669	5 5.68
Austrian Sclaves	Novara	1.669	5 5.68
Galchas, Iranian mountaineers	Ujfalvy	1.668	5 5.66
Spaniards, U. S., immigrants	Baxter	1.668	5 5.66
Berbers of Algeria	Topinard	1.666	5 5.62
Portuguese, U. S., immigrants	Baxter	1.663	5 5.43
Arabs	Rosky	1.660	5 5.33
Austrian Germans	Novara	1.658	5 5.27
French working classes	De Quatrefages	1.657	5 5.24
Eskimo, N. A.	Various	1.654	5 5.10
Hungarian (military statistics)	Scheiber & Beddoe	1.652	5 5.04
Caucasians	Shortt	1.650	5 4.93
New Guinea	Various	1.646	5 4.78
Hurloos	Shortt	1.645	5 4.76
Bavarians	Novara	1.643	5 4.68
Ruthenians	Majer & Kopernicki	1.640	5 4.54
Dravidians	Shortt	1.639	5 4.50
Cingalese	Davy	1.638	5 4.48
Austrian Roumanians	Novara	1.631	5 4.37
Chinese	Novara	1.630	5 4.17
Italian conscripts (1.620)	An. di Statist. 1879	1.626	5 4.00
Fuegians	Novara	1.625	5 3.98
Polish Jews	Mayer & Kopernicki	1.623	5 3.88
Poles	" "	1.622	5 3.87
Finns (Beddoe, 5 ft. 5.81)	Novara	1.617	5 3 60
Papuans	Various	1.606	5 3.20
Japanese	Mrs. Ayrton	1.604	5 3.11
Aymaras, Peru	Forbes	1.601	5 3.00
Peruvians	D'Orbigny	1.600	5 3.00
Cochin Chinese	Finlayson	1.593	5 2.70
Malays	Raffles, Crawfurd, &c.	1.583	5 2.34
Veddas of Ceylon	Bailey	1.536	5 0.42
Lapps	Horch	1.500	4 11.2
Andamanese	Man	1.492	4 10.7
Aëtas	De Quatrefages	1.482	4 10.3
Semangs	De Quatrefages	1.448	4 9.0
Mincopese	De Quatrefages	1.436	4 8.53
Bosjesman	Various	1.341	4 4.78
Differences between the tallest and the shortest		.421	1 4.55
Average stature of man		1.658	5 5.25

ANTHROPOLOGY AT THE NATIONAL CAPITAL.—The city of Washington is becoming such an important center of anthropological material and research, that students in other places are likely to become confused in seeking for any special information. To prevent embarrassment it is well to bear in mind the following facts:

1. In the Smithsonian building proper is the Department of Antiquities, in charge of Dr. Charles Rau. Here are deposited all relics recovered from mounds, graves, ancient structures, caves, shell-heaps, etc., situated in our own country; all relics of antiquity from abroad; and the artefacts of stone, bone, shell, ivory, etc., found in the United States and known to be the handiwork of the aborigines. Many other typical objects of culture are also on exhibition in Anthropological hall. Archæologists visiting the capital will naturally make this collection the central point of their investigations. A more minute description of Dr. Rau's work will be given in a subsequent number of the NATURALIST.

2. Under its present organization the National Museum has a Department of Arts and Industries, of which Professor G. Brown Goode is curator. One section of this department embraces savage and barbarous industries, and to this we now direct especial attention. No professional ethnologist is in charge, but Mr J. K. Goodrich is engaged in arranging the material, and Ensign Albert P. Niblack. U.S.N., has been detailed to study here. This branch of the museum has, for a nucleus, the Wilkes collection, and it includes all the specimens formerly combined with Dr Rau's department, but not representative of the stone age. From all parts of the world objects have come to enrich this ethnologic treasury, and it would be impossible to mention even the names of the contributors. The Centennial Exhibition at Philadelphia was the means of greatly enhancing the store. During the past year most valuable additions have been made to this part of the National Museum.

Mr. C. L. McKay, signal officer, recently drowned in the Alaskan seas, sent over a hundred specimens of the hunting and fishing apparatus used by the natives of Bristol bay.

Mr. J. J. McLain, signal officer, gathered a typical set of textile work and a number of pipes from the vicinity of Sitka.

Mr. W. J. Fisher, in the same service, donated over 150 specimens of dance ornaments, weapons and household utensils from the same region.

Mr. Stejneger, signal officer, made fine collections on Bering isles, Commander group.

The National Museum has succeeded in effecting an exchange with the Leipzig museum, founded originally in Dresden by Dr Gustav Klemm, by which a large number of tools and weapons from the west coast of Africa have come into possession.

Lieutenant Ray gathered at Point Barrow an illustrative series of Eskimo objects.

Collections of musical instruments have been contributed from Tiflis, and by Mr. J. H. Foot, of New York.

The Bureau of Ethnology has just turned over to the museum its entire store of pottery, ceremonial apparatus, foods, textile fabrics, arms and implements from the Zunis and the Moquis. This gift includes many thousands of specimens.

The most interesting addition made to the museum by any of its special agents last year, was that secured by Mr. J. G. Swan, of Washington Territory. It consists of miscellaneous objects gathered along the north-west coast from Sitka to Puget sound, together with exhaustive types from the Haidahs and the Makahs. From the former come the beautiful objects in carved slate. Besides the miniature totem posts, with their allegorical figures and a great variety of dishes and pipes, there are square covered boxes, richly ornamented, that would hold five or six gallons. The Makah material, gathered with special reference to the London fishery exhibition, includes every kind of object that enters into this industry among this tribe.

3. The Bureau of Ethnology is under the direction of Major J. W. Powell. Its function is to study the anthropology of the North American aborigines, living and extinct. The work of the several parts of this bureau will be more fully described in the future.

All of the institutions just described are more or less officially connected with the Smithsonian Institution, under the direction of Professor Spencer F. Baird. The first named has for its medium of publication the Smithsonian Contributions to Knowledge, Miscellaneous Collections, and Annual Report; the second makes known its operations through the Proceedings of the National Museum; and the Bureau of Ethnology publishes its Annual Report, and Contributions to North American Ethnology.

4. The Army Medical Museum, under the official direction of Dr. Robert Murray, Surgeon-General, U. S. A., and in charge of Dr. John S. Billings, is devoted to anthropology in its more restricted sense. Here are deposited crania, skeletons, preparations of soft parts, microscopic sections, etc., relating to the human body. It is here also that the great Index-Catalogue is made up and Index Medicus is edited.

5. The Anthropological Society of Washington, numbering now one hundred and fifty members, holds its meetings at the Army Medical Museum, on the first and the third Tuesday in each month. The society has published two volumes of Transactions and is in a flourishing condition. Major J. W. Powell is president for 1884, and Colonel F. A. Seely, U. S. Patent Office, is secretary, to whom all communications should be addressed.

There are many departments of the Government where anthropological material is gathered and where excellent contributions

are made to this science. Indeed, there is not a single department of anthropology that is not well represented in Washington. The Patent Office, the Census Bureau, the Board of Health, the Department of Agriculture, the Signal Office, the Indian Office are only a few of these. Further reference to some of these institutions and their operations will be made in future numbers of the NATURALIST.

MICROSCOPY AND HISTOLOGY.[1]

METHODS OF INVESTIGATING ANIMAL CELLS.—Dr. Brass has devoted several years of close study to the structure and life of animal cells, and a detailed account of his methods appears in the first number of a new journal of microscopy.[2] The following are some of the more important of these methods:

1. *Protozoa.*—As most Protozoa move very rapidly when hungry, it is well to feed them before attempting to study them with the microscope. If well fed with powdered pieces of plants, &c., they usually remain quiet after a short time, and begin to assimilate the food-material which they have appropriated. In this condition of comparative quiet they can be easily examined with high powers. For this purpose they may be placed under a cover-glass with considerable water and a number of small green algæ to keep the water supplied with oxygen.

For higher powers Abbe's illuminating apparatus is extremely useful. In some cases it is desirable to have a completely one-sided illumination, and this is best effected by inserting beneath the illuminating apparatus a circular diaphragm-plate perforated with a slit 3^{mm} wide that runs parallel to the edge of the plate. It is best to have about 2^{mm} between the slit and the edge of the plate. Several diaphragm plates should be prepared in which the slit varies in extent from a half to a whole of a quadrant or more.

The following mixture, which is Meckel's fluid with the addition of a little acetic acid, is recommended above all other reagents as a preservative medium:

Chromic acid	1 part
Platinum-chloride	1 "
Acetic acid	1 "
Water	400–1000 "

Unicellular animals die very slowly in this mixture, and suffer very much less alteration in structure than when killed in osmic acid or picro-sulphuric acid.

A special method is required for Protozoa filled with opaque food-material. In many cases the nucleus and the structure of the cell-body are completely obscured by foreign bodies. The method adopted in such cases is as follows:

(1) Placed in picro-sulphuric acid 3–4 minutes.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

[2] *Zeitschr für wiss. Mikroskopie*, I, No. 1, pp. 39–51, 1884.

(2) Transferred to boiling hot water for a short time.

(3) Placed in water and a little ammonia added; this causes the contracted object to swell up to its original size and form.

(4) Neutralize the ammonia with a little acetic acid, and then

(5) Color with borax-carmine or ammonia-carmine.

(6) Wash and examine in dilute glycerine.

The piero-sulphuric acid destroys the nutritive material; the ammonia dissolves any particles of fat that may be present; and thus the object becomes transparent so far as possible.

A concentrated solution of corrosive sublimate may also be used with success for killing Protozoa; but care must be taken to wash thoroughly.

Dr. Brass has obtained his best results without reagents or dyes.

2. *The nature of Chromatin.*—Dr. Brass has advanced an entirely new theory in regard to the colorable portion of the nucleus. Hitherto it has been very generally supposed that the chromatin (Flemming) plays an important part in cell division, but Dr. Brass maintains that it represents simply surplus food-material. This opinion is supported by the fact that well-fed cells contain chromatin in abundance, while cells deprived of food for a considerable time appear to lose the chromatin.

Pfitzer's Method of Coloring and Hardening at the same time.[1]—To a saturated aqueous solution of picric acid add a small quantity of an aqueous solution of nigrosin. This gives a deep olive-green mixture which kills very quickly and stains at the same time that it hardens. After a few hours' immersion the object may be transferred to water or alcohol for removing the acid and the nigrosin which remains in solution.

This method is very good for preparing small objects that have to be killed, hardened, stained &c., under the cover-glass.

Filtering Reagent Bottle.[2]—The usual forms of filters of paper and cotton are not as convenient as one could wish, and it was with a view to the production of a simple apparatus which would deliver, perfectly filtered, any quantity of a staining-fluid, or other reagent from a single drop to a dishful, that I devised, about two years ago, the bottle here described. A wide mouth bottle of convenient size is fitted with a cork through which three glass-tubes are passed; one of which (Fig. 1, *a*) reaches nearly to the bottom of the bottle, while the other two tubes extend only just below the cork.

The long tube is curved above the cork, and at a point just beyond the curve there is attached to it a short piece of tubing of twice the diameter of the first. The lower end of this larger tube (at *d*) is also fitted with a cork, through which passes a short piece of small tubing, which is slightly contracted at its distal end.

[1] Ber. Dtsch. Botan. Gesellsch., 1, No. 1, p. 44, 1883.
[2] Devised by C. E. Hanaman.

Over the cork and open end of this short delivery tube, a piece of fine muslin (*d*) is stretched, and the space (*b*) in the large tube is filled with a loosely packed plug of absorbent cotton, forming an effectual filter. The second tube ends above the cork in a "thistle-bulb" funnel (*e*), the opening in which is formed into a neck of sufficient length to enable one to cork it securely. Through this thistle-top tube the reagent may be readily poured from a dish or other vessel. The third tube (*g*) is bent over the side of the bottle and a piece of rubber tubing is attached, which may end either in a short glass mouth-piece or atomizer-bulb, as the student may elect. In case the bulb is used it will be found necessary to loosen the cork in the funnel-tube (*e*) when a sufficient quantity of the contents has been expelled, in order to release the pressure and stop the flow.

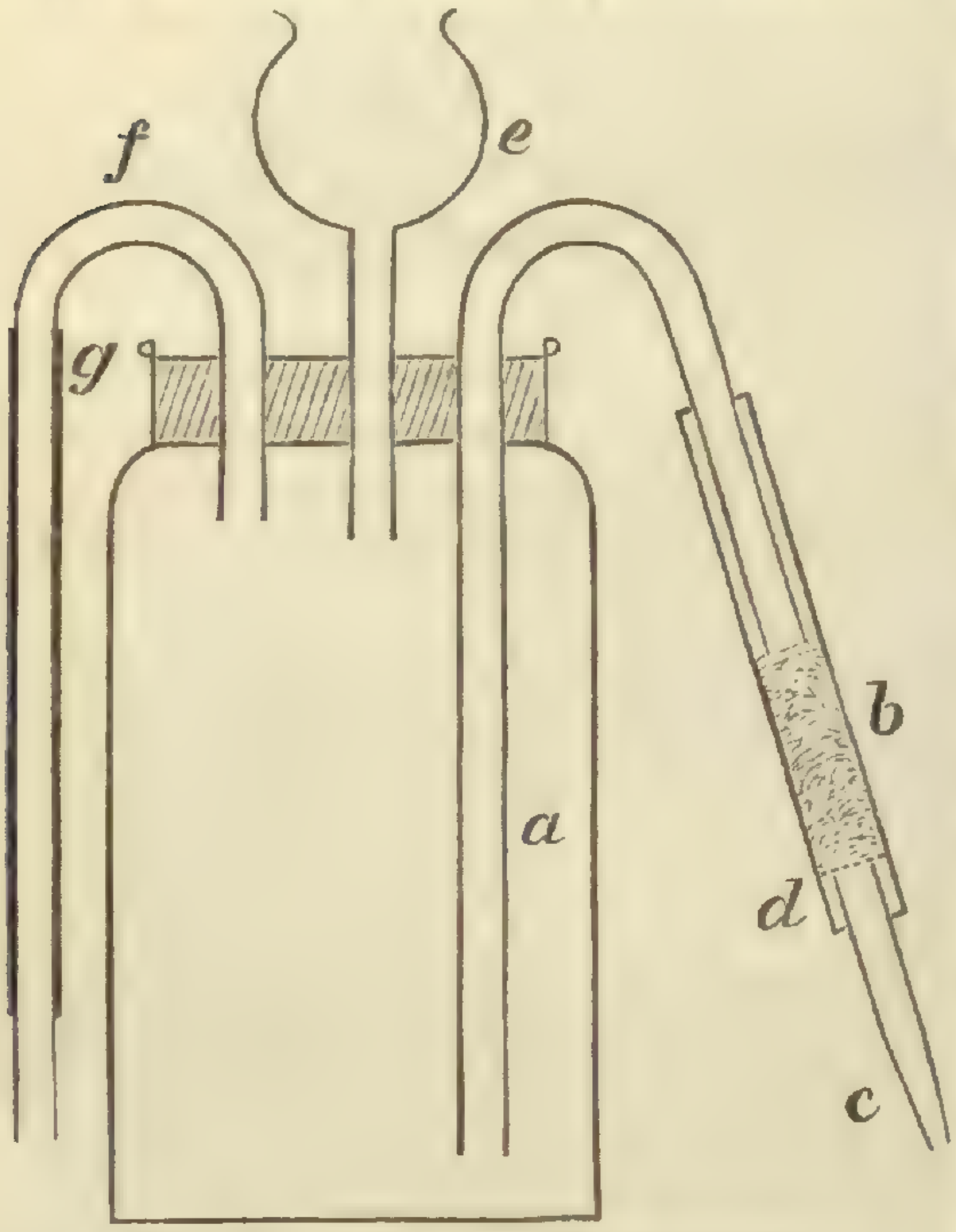

FIG. 1.—Filtering Wash-bottle.

This bottle differs from the one described at Montreal only in the use of the thistle-top tube and common bottle, in place of the more expensive three-neck or Wolfe's bottle. The thistle-top tubes may be purchased for about fifteen cents apiece, while the Wolfe's bottle would cost fifty cents or more.

Further, the thistle-funnel permits a solution to be readily poured into it from a dish, while the necks of the Wolfe's bottle are so small that the use of a funnel is necessary, except when the solution is poured from a spout or bottle-neck. Stains may thus be returned to the bottle and used over and over again, being perfectly filtered each time they pass through the plug of cotton. A gentle breath at the mouth-piece, or a slight compression of the bulb, expels a single drop, while by blowing steadily for a moment, or rapidly working the bulb, a dishful of the reagent is obtained.

When the plug of cotton becomes foul, which will not be for a long time, even with hematoxylin stain, it may be replaced by a fresh one by simply uncorking the lower end (*d*) of the large tube, pulling out the old plug with a pair of forceps and inserting a fresh one. The cotton should be but loosely packed to work easily. If the contracted end of the delivery tube becomes clogged through long disuse, it may be freed with a pin or fine wire, and the first dishful of the reagent returned to the bottle, when it will be found that the succeeding dishful will be perfectly filtered.—*From the Am. Mo. Mic. Jour. March, 1883.*

NOTES ON THE USE OF THE FREEZING MICROTOME.[1]—The tendency at the present time is to make all microscopic sections by the dry method after paraffin infiltration and imbedding; but no doubt there is a place, and an important one, for the freezing microtome in practical histology, and in this note I would like to call the attention of the readers of *Science Record* to what seem to me improvements in its use. Disliking greatly the disagreeable "muss" made by ice and salt, it occurred to me to take advantage of the device of plumbers to thaw out water and gas pipes, to use strong alcohol with the ice or snow instead of salt. By using snow or finely powered ice and ninety-five per cent alcohol, a temperature of twenty centigrades below zero is obtained within five minutes, and this temperature may be maintained with far less trouble than with ice and salt. The microtome used is the Rutherford pattern modified by placing the drain near the top instead of in the bottom. A rubber tube passing from this drain to a jar, preserves the overflow. It requires about 250 cc. of alcohol to freeze and keep frozen one tissue for cutting, but this is not lost, as little evaporation takes place and the dilution does no harm for many purposes, hence the method is not wasteful, while it is much more pleasant and expeditious than with salt.

Ordinarily tissues are infiltrated with thick gum before freezing, and then the sections are soaked in a relatively large amount of water to remove the gum. Evidently while soaking, staining and transferring the sections, especially if they be of such an organ as the lungs, there is every liability of their becoming folded or torn. This may be avoided by staining the tissue in the mass as for dry section cutting, and then soaking in water to remove any alcohol, and finally completely infiltrating the tissue in a thick solution of very clean gum arabic. When ready to make the sections the well of the microtome is filled with the thick gum and the tissue introduced at the proper time as usual. Before cutting the gum is cut away from the tissue, as in sharpening very bluntly a lead pencil, then as the sections are cut they are transferred directly to the slide. After several slides are filled, a drop of glycerine is added to each section and the cover-glass applied. This is practically mounting in Farrant's solution.

Instead of using gum arabic, Professor Sollas[2] recommends gelatine prepared as for glycerine jelly. This is used in every way as described for the thick gum, and the sections are placed upon the slide and covered with glycerine and the cover-glass applied. In this modification the sections are practically mounted in glycerine jelly. The cover-glass may be sealed in any approved way for either of the methods just described.—*S. H. Gage, Cornell University, March 1, 1884.*

[1] From *Science Record*, No. 6, April, 1884.

[2] Professor J. Sollas. An improvement in the method of using the freezing microtome. *Quarterly Journal of Microscopical Science*, Jan., 1884, p. 163.

SCIENTIFIC NEWS.

— In examining sponges Mr. H. J. Carter, according to the Journal of the Royal Microscopical Society, finds that the quickest way is to soak a microscopic fragment of it in distilled water for from twelve to twenty-four hours, then tease it to pieces on a slide, drain, dry, and mount with balsam as usual; but to be *certain* of the exact form of its spinules requires that they should be boiled out with nitric acid, which may be easily and quickly effected by placing the microscopic fragment on the centre of a glass slide and covering it with a drop or two of nitric acid, then boiling this over a spirit lamp with a low flame till it is nearly dry, after which the same process must be repeated twice or thrice; and, finally, before the last drop of nitric acid is entirely dried up, removing the slide to the table when through gradually increased inclination and sufficient careful edulcoration with distilled water, the residuum may be freed from all remaining acid, drained, dried, and mounted in balsam; or if desired, another microscopic fragment, prepared as first-mentioned, may be added to it previously, when the perfect form of the spicules respectively, together with their position *in situ*, may be seen at once in the same preparation.

— Mr. H. P. Aylward, according to the *Journal* of the Royal Microscopical Society, has designed a set of apparatus for pond life hunting, the novel feature of which is that the holder for the bottle is made of steel wire, one end grasping the neck of the bottle, and the other end being a hollow spiral, in which the ferrule end of any sized walking stick may be inserted. The hook is similarly attached to a spiral. The dipping-bottle packs in a japanned cylindrical tin box, the upper half of which is composed of very fine copper gauze. When the bottle is emptied into this box, the organisms will be retained in the lower part and the surplus water escape through the gauze. This operation may be repeated any number of times, and the contents afterwards returned to the bottle. For special gatherings, another japanned box is supplied, containing several large test-tubes. The size of the cylindrical box and its case containing the bottle is 5 in. × 2 in., that of the box with test-tubes, 5½ in. × 3 in. × 1 in.

—The Entomological Society of Washington has organized with the following officers: President, Dr. C. V. Riley; first vice-president, Dr. J. G. Morris; second vice-president, Geo. Marx; recording secretary, E. A. Schwarz; corresponding secretary, L. O. Howard; Treasurer, Ben. P. Mann; executive committee, the officers and Dr. W. S. Barnard, P. R. Uhler and Dr. A. J. Shafer.

The first regular monthly meeting of the society was held April 3d, in the council chamber of the U. S. National Museum. The following papers were read: 1. Some new facts concerning the

late Dr. Townsend Glover, by C. V. Riley. 2. On insect collecting at Pt. Barrow, Alaska, by John Murdoch. 3. On the insect fauna of the District of Columbia, by E. A. Schwarz. 4. On the so-called "mistaken parasite," by L. O. Howard.

The active membership list of the society numbers over twenty names. Meetings are held on the first Thursday evening of each month.—*L. O. Howard, corresponding secretary.*

—The only American sea-side laboratory now open to students and investigators in general is that sustained by the Boston Society of Natural History at Annisquam, Mass. The session begins June 20th, and closes September 7th, 1884.

The work in the laboratory will be under the immediate care of Mr. J. S. Kingsley during June and July, and Mr. B. H. Van Vleck, assistant in the laboratory of the Boston Society of Natural History, during August.

Applications for entrance should be made to Professor A. Hyatt, custodian of the Society of Natural History, Boston, Mass.

—The final outburst of the Krakatoa volcano took place at 12 minutes to noon on August 27th of last year, and a great tidal depression was created in the Straits of Sunda. At 1.30 p. m. of the same day a wave was felt at Pointe de Galle, in Ceylon, 3000 kilometers distant, and at 2 15 p. m. one was felt at Mauritius, 5500 kilometers distant. Calculating from these observations, M. de la Croix, a French physicist, estimates the velocity of the molecular disturbance through the water of the ocean to be 2000 kilometers per hour, 550 meters per second higher than the recognized velocity of sound in air.—*The English Mechanic.*

—The total amount appropriated to the French Institute in the Budget for the year 1884, is 720,000 francs, of which the Academie Française receives only 98,000 francs, and the Academie des Sciences as much at 203,000 francs. Every member of each section of the Institute receives 1500 francs a year, the permanent secretary of each section, 6000 francs; the remainder is for special work, memoirs, prizes, etc.

—M. Girard has bequeathed to the French Association for the Advancement of Science, a capital sum of 100,000 francs, the interest of which is to be devoted every five years to the encouragement of researches into the antiquity of man, with especial reference to geological time.—*The Academy.*

—Professor Allen Thomson, of London, well known for his writings on embryology, recently died at the age of 75. His professorial life dates from 1839, when he was appointed to the chair of anatomy in Marischal College, Aberdeen. From 1848 to 1877 he was professor of anatomy in the University of Glasgow; but in the latter year, having been appointed president of the British Association (Plymouth Meeting), he retired from professorial life, and settled in London. Allen Thompson published only one "book," his "Outlines of Physiology" (1847), but he wrote many

papers, and contributed numerous articles to the cyclopædias. Thomson early saw the truth in the theory of evolution, and taught it when it was not fashionable.

— Dr. George Engelmann, born at Frankfurt on-the-Main February 2d, 1809, died, in the midst of his scientific labors, at his home in St. Louis, on Monday, February 4th, 1884, in the seventy-fifth year of his age.

—The grand honorary Walker prize of $1000 has been awarded by the Boston Society of Natural History to Professor James Hall, of Albany, for his palæontological investigations.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

NATIONAL ACADEMY OF SCIENCES, April 15–18.—The number of members present was nearly forty, the session lasting four days. An interesting feature of the meeting was the announcement that Mrs. J. Lawrence Smith has presented, as a memorial of her husband, a member lately deceased, a fund of $8000 for the promotion of research on meteorites. Five new members were elected, viz., Edward S. Dana, C. B. Comstock, S. I. Smith, C. E. Dutton and W. K. Brooks.

The following papers were read:

The sufficiency of terrestrial rotation to deflect river courses. G. K. Gilbert.
The origin of crystalline rocks. T. Sterry Hunt.
On the photographs of the transit of Venus taken at the Lick observatory. Simon Newcomb.
Zoölogical results of the deep-sea dredging expedition of the U. S. Fish Commission steamer *Albatross*. A. E. Verrill.
The quantitative estimation of carbon in ordinary phosphorus. Ira Remsen.
Reduction of halogen derivatives of carbon compounds. Ira Remsen.
Reduction of barometric observations to sea level. Elias Loomis.
The study of comparative biography. C. S. Peirce.
Whether there is a minimum perceptible difference of sensation. C. S. Peirce and J. Jastrow.
The character of the heat radiated from the soil. S. P. Langley.
On the depth of the western part of the Atlantic ocean and Gulf of Mexico, with an exhibition of a relief model. J. E. Hilgard.
On the relative levels of the western part of the Atlantic ocean and Gulf of Mexico with respect to the Gulf Stream. J. E. Hilgard.
On the structure and affinities of Didymodus, a still living genus of sharks of the Carboniferous period. E. D. Cope.
On the North American species of Mastodon. E. D. Cope.
The characteristics of the Lyomerous Fishes. Theo. Gill and John A. Ryder.
On the classification of the apodal fishes. Theo. Gill and John A. Ryder (by invitation).
On the ichthyological peculiarities of the Bassalian realm. Theo. Gill.
On the fritts selenium cell. Geo. F. Barker.
On a lantern voltmeter. Geo. F. Barker.
On the occurrence of mercury in native silver from Lake Superior. Geo. J. Brush
Progress in making a new photograph of the spectrum. H. A. Rowland.
On the existence of tin ore in the older rocks of the Blue Ridge. B. Silliman.
The Krakatoa atmospheric waves and the question of a connection between barometric pressure and atmospheric electricity. H. M. Paul (by invitation).
Memorandum on composite photographs in craniology. John S. Billings.
Some experiments upon the spectra of oxygen. A. W. Wright.

On the application of trinomial nomenclature to zoölogy. Elliott Coues.
Some recent results of the oral and aural teaching of the deaf under the continued system. E. M. Gallaudet (by invitation).
Jade implements from Alaska. F. W. Clarke.
Recent progress in electrical fuses. Henry L. Abbott.
The volcanic sand which fell at Unalashka, Oct. 20, 1883, and some considerations concerning its composition. J. S. Diller (by invitation).

Biographical memoirs of Gen. G. K. Warren, by Henry L. Abbott; of Professor Stephen Alexander, by L. A. Young; of Dr. J. Lawrence Smith, by B. Silliman, and of Dr. John L. LeConte, by S. H. Scudder, were read at an evening session of the academy.

Biological Society of Washington, April 5.—Communications by Dr. Leonhard Stejneger on the shedding of the claws in ptarmigan; by Mr. William H. Dall on the fishery exports of San Francisco in 1883; by Professor C. V. Riley on rusty oranges; Mr. F. A. Lucas exhibited a series of skulls of American Canidæ; Dr. D. E. Salmon remarked on the recent outbreak of the so-called "foot and throat disease" in the West; Dr. E. P. Howland on the effects of anæsthetics on the animal organization, with experiments and clinic on animals, showing the peculiar effects of the new anæsthetic, nitrous oxide and oxygen, administered in condensed air chambers.

April 19.—Communications by Dr. Cyrus Thomas on the growth of trees as a means of determining the age of mounds; by Mr. John Murdoch on dredging and marine collecting at Point Barrow; by Dr. Tarleton H. Bean on the distribution of the Salmonidæ in Alaska; Dr. R. W. Shufeldt, U.S.A., on the occurrence of a pair of free ribs on the occipital bone of the large-mouthed black bass, *Micropterus salmonides*, with specimen.

New York Academy of Sciences, April 7.—A paper on the hydraulics of the Mississippi from Cairo to the gulf was read by William L. Elseffer, C.E.

April 14.—The following paper was read: The uniformity of geological climate, by Professor Charles B. Warring.

April 28.—The following papers were read (in continuation of the subject presented on March 10): II. The "singing beaches of the Baltic; III. The sonorous sand-hills of Arabia and Afghanistan, by Professor H. Carrington Bolton.

Boston Society of Natural History, April 2.—Professor G. Fred. Wright spoke of the glacial dam at Cincinnati, and on the boundary of the glaciated area of Indiana; Professor Edw. S. Morse discussed the ancient and modern methods of arrow release.

April 16.—Dr. M. E. Wadsworth presented a paper on the relation of the "Keweenawan series" to the "Eastern sandstone" in the vicinity of Torch lake, Michigan.

APPALACHIAN MOUNTAIN CLUB, April 9.—A paper by Professor W. W. Bailey entitled, "Recollections of the West Humboldt mountains, Nevada," was read; Rev. Luther Farnham read a paper entitled, "Three Visits to the White mountains in 1837, 1862 and 1883;" Information was given concerning recent ascents in New Zealand among the Himalayas.

AMERICAN GEOGRAPHICAL SOCIETY, March 31.—Chief-Justice Daly, LL.D., delivered his annual address as president of the society, entitled recent developments in Central Africa and the valley of the Congo.

April 25.—General Jas. Grant Wilson delivered a lecture entitled memorials and footprints of Columbus, illustrated with stereopticon views.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Jan. 31.—Dr. Leidy exhibited some fossil bones from the salt mine of New Iberia, Louisiana, including remains of *Equus americanus* and two tibiæ of an adult Mylodon. A piece of matting had been found in association with mastodon teeth, but there was no evidence of their contemporaneity. Dr. Leidy stated that he had found in specimens of drift from Central Minnesota, two species of foraminifera so closely resembling *Textularia globulosa* and *Rotalia globulosa* that no distinctive characters could be determined.

Feb. 2.—A paper by Miss Foulke, describing *Apsilus bipera* was read. The author united Apsilus, Dictyophora and Cupelophorus under Apsilus. Professor Lewis announced the discovery of fossils in the Triassic red shale near Phœnixville, in a stratum probably 1000 feet below those previously discovered near that place. Five species of lamellibranchs, a fish and some plants were among the remains. The two species of Unio were regarded as probably the most ancient yet discovered. Professor Heilprin stated his belief that some of the Carboniferous bivalves which had been described under other names were true Unios.

Feb. 14.—Dr. McCook exhibited a drawing of the nest of the California spider, *Pucilia aurora*, which places its cocoons under flowers, and secures them by a maze of lines to the neighboring branches. The speaker also described the cocoons of *Segestrocanites*, which are placed one above the other to the number of eight, and held in place by lines to the branches on each side of a pathway. A tube, the home of the spider, runs up one side of the suspended nests. The cocoons were frequently torn away by passing animals, but this simply aided distribution. An example of *Nephila plumipes* from the silk of which species Professor Wilder had woven small ribbons, was exhibited. Mr. Potts gave an account of the sponges found in the forebay of the Philadelphia water-works, and announced his belief that the sarcode of fresh-water sponges does not slough off at the approach of winter, and therefore that these organisms do not pollute the water. He believed that the whole of the sarcode retired into the statoblasts, from which it issued again in spring.

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NOTES ON A NEW INFUSORIAN.

BY DR. ALFRED C. STOKES.

EARLY in the spring of last year (1883), I gathered a quantity of Lemna from a pond whose surface was so completely covered by the little plants that they seemed to be jostling each other for growing room. The water beneath must have been quite dark, being lighted probably only by so much of a faint green glimmering of sunbeams as the Lemna could transmit, yet that shallow pond contained myriads of living creatures. For eight months or longer the gathering has stood neglected upon my table, a little fresh water being occasionally added to supply that lost by evaporation, and it is still clear and untainted, although every frond has lost its rootlets, and the greater number have gone to decay, and though many generations of Infusoria, rotifers and Turbellarian worms have come and gone, and added their little to the residual detritus covering the bottom of the vessel. The Infusoria, therefore, now living within the restricted habitat of this glass saucer cannot be considered as Infusoria of putrid waters, and those recently appearing there in midwinter are probably from germs forced into development by a kind of hot-house process in a warm room. The same forms might be taken in season from the original pond itself. They seem, however, to have hitherto escaped observation, and as they possess structural peculiarities which, so far as the writer can learn, are limited to their own little bodies, it is necessary to erect not only a new species for their reception, but a new genus.

The body of the Infusorian, which I have named *Ctedoctema acanthocrypta*, gen. et sp. nov., is soft and flexible, but persistent in

shape, its form being elongate-ovate, subcylindrical and slightly compressed, widest and rounded posteriorly, thence tapering evenly to the obtuse mesially placed anterior point. The entire cuticular surface is ciliated, the cilia being long and fine, their length often exceeding the short diameter of the body. They are arranged in rows that are more distinctly seriate on the dorsal aspect. Ventrally their arrangement is more irregular, and here they seem to be constantly in motion. All are flexible and all are at times put into vibration, but each individual filament upon the lateral and dorsal surfaces is capable of independent movement. When their tips are focussed, scattered cilia are seen to tap and patter against the cover-glass, and the four or five stiffer, more setose hairs projecting from the posterior extremity quiver and occasionally lash the water as if the animal had hardly time to eat. One of these postero-terminal cilia has its distal extremity conspicuously curved, as is shown in the figures. When the infusorian is at rest, the cuticular cilia, with the exception of those on the ventral aspect, do not vibrate but stand out from the surface like long bristles; at such times the only additional actively moving cilia are those of the oral series and a single row on the left lateral body margin. As the creature is rapidly swimming, to distinguish whether any or all of the cilia are in motion is next to impossible. It is only during the moments preceding death by iodine poisoning that the question can be answered, as it is in the affirmative, not a cilium then being idle.

In its movements the creature is wonderfully swift, darting across the field so quickly that the looker-on can only see that something has passed by. Even when a pleasant feeding ground is discovered under the lee of an algous filament or a particle of dirt, the lively animal cannot rest, but at frequent and almost regular intervals darts forward for one-half its length and as quickly slips back to its former position. In this rhythmic swing it seems to use the tips of the supporting cilia as fulcra, thus converting itself into an animated lever of the third class, where the power is between the weight and the pivot.

In Fig. 1 Ctedoctema is represented in its dorsal aspect, drawn with the camera lucida and magnified 700 diameters. Its extreme length is $\frac{1}{1000}$ inch. The nucleus, as shown in the figure, is ovate and situated about mesially in the anterior body half. The pos-

sting vacuole, sub-terminally located below and to the right of the median line, contracts at intervals of six seconds.

The infusorian has the inexplicable habit of protruding sub-terminally on the left dorso-lateral margin, a colorless, semi-transparent hemisphere of the body sarcode, in which there is often a circulation of the minutely granulate protoplasm. The object of this bubble-like protrusion, as intimated, I have been unable to determine. It was at first mistaken for the beginning of a temporary anal aperture, but such use of it has not been observed. It is frequently withdrawn, leaving a lighter smooth spot in its place.

But it is on the ventral surface that we find most of the creature's peculiarities. Originating at the anterior margin and ex-

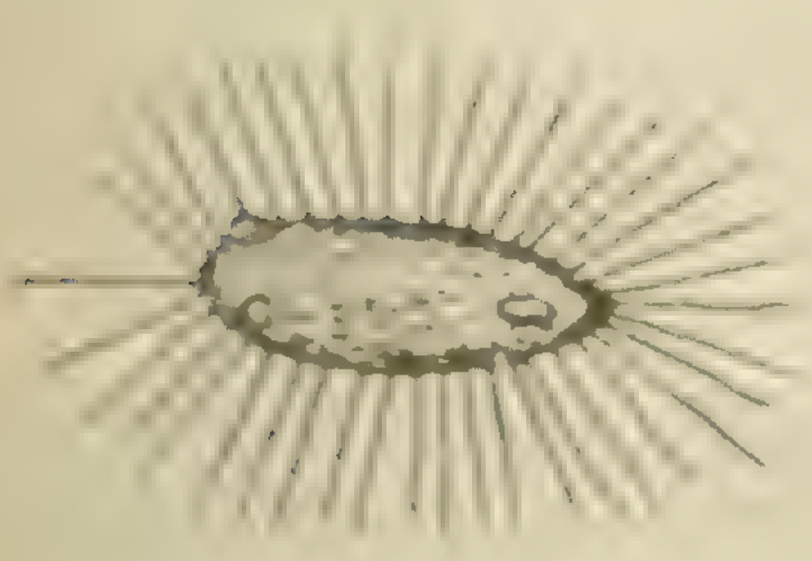

Fig. 1.

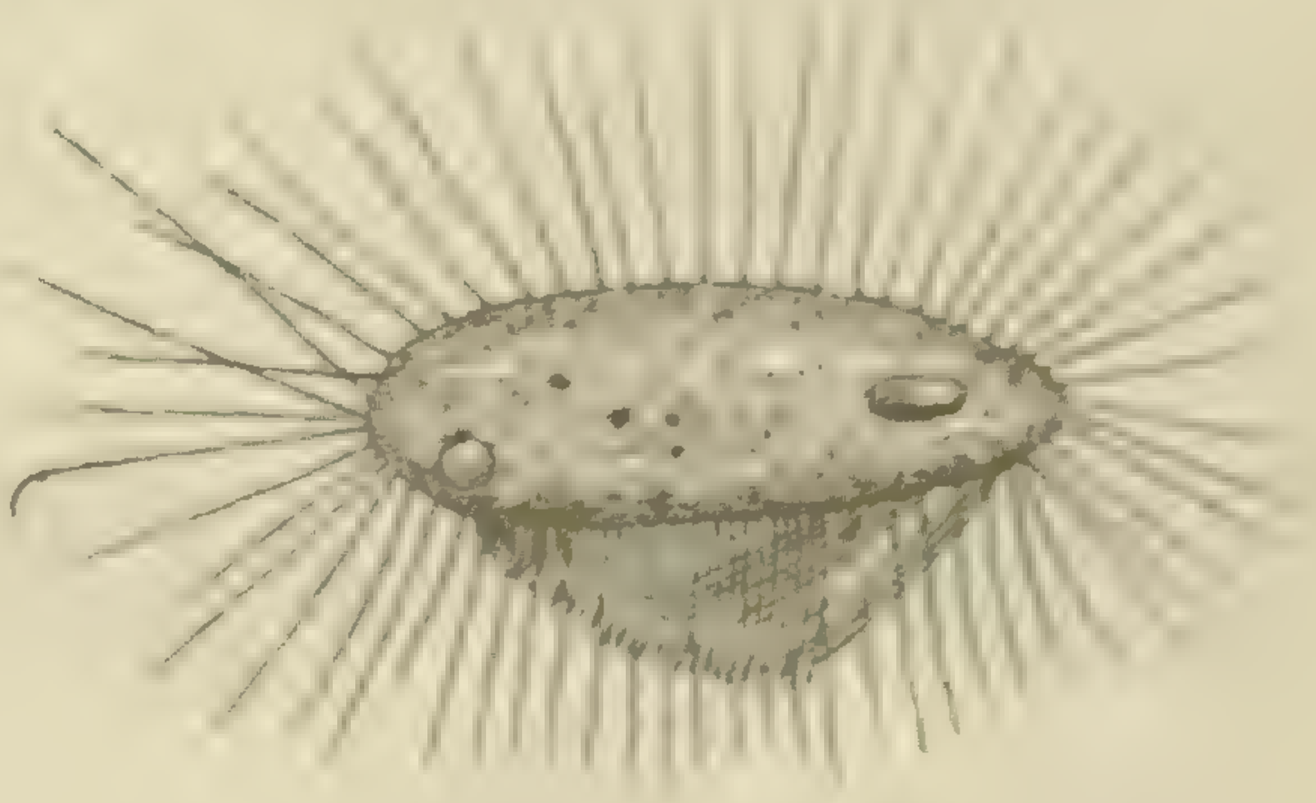

Fig. 2.

Fig. 1.—*Cleistotema acanthocrypta*, gen. et sp. nov. Dorsal aspect. × 700. Fig. 2.—Lateral aspect.

tending almost centrally across the ventral surface, but somewhat obliquely backward and inward, for a distance equal to three-fourths of the animal's entire length, is a shallow, narrowly ovate groove, at whose posterior and widest and deepest part the oral aperture is placed. This depression, narrowest at its anterior origin and gradually and regularly widening to its rounded posterior termination, is clothed with long fine cilia for about two-thirds of its length. The longest of these vibratile hairs are in length nearly equal to the animal's transverse diameter, being longest and somewhat fasciculately clustered on the extreme anterior margin, thence becoming gradually shorter until about two-thirds of the groove are supplied. They seem to be absent from the remainder of the depression with the exception of the space immediately around the oral aperture, where they are visible only in their effect and in the peculiar glimmering appearance which they produce, that shimmering of the surface like the wavering of heated

air which one so soon learns to associate with the action of fine cilia. When the animal is swimming, those anteriorly placed are snugly packed away longitudinally in the adoral groove. Occasionally they are quiescent long enough at other times to exhibit their length and tufted arrangement, when they are held arcuately parallel with and below the adoral depression.

Near the left hand margin of this elongated sinus is a single row of long fine vibratile cilia, whose points of attachment are much more widely separated than those on the general cuticular surface. Their vibrations seem to be at right angles to the course of the adoral groove, but the facility with which the direction of movement in such delicate filaments may be misinterpreted is remarkable. After those intervals, few and far between and at best of but momentary duration, when they become quiet and visible, their action certainly seems to be renewed, and they to fade from view, as the animal lies upon its side, not by a lateral sweep but by a downward flashing of the whole series; that such is the fact, however, I am not prepared to say; it only seems so.

Attached to the right margin of the adoral sinus is a symphony in cilia which, so far as I am aware, is possessed by no other infusorian. It is really musical in the beauty and the harmony of its arrangement. The ciliary constituents of this delightfully satisfactory series are each much coarser and stouter than any others on the creature. Placed in a single row and slightly curving over the adoral depression, they begin anteriorly at a distance from the frontal margin equal to about one-third of the entire length of the groove, the first and foremost cilium being scarcely shorter than the animal's transverse diameter, the length of each succeeding one becoming a little less than the preceding, until the last just rises above the surface immediately behind and somewhat to the left side of the oral aperture. Each member of this comb-like appendage not only curves in accordance with the regular curvature of the series, but has a distinct thickening of its distal extremity whereby that free end is brought into apparent contact with its neighbor. Under insufficient magnifying power this state of affairs presents the aspect of a long curved posteriorly originating flagellum, or the lowermost outline of an adoral hood; and when thus examined the animal presents a striking resemblance to Pleuronema or Cyclidium. Indeed, we have only to imagine the former as having divided its hood-like velum

longitudinally and split up each moiety into transverse filaments, when the resultant creature would bear a strong likeness to Ctedoctema, and would probably be relegated to the same genus. As it is, the observer must be in some doubt as to the ordinal position of Ctedoctema. Does it, in common with Cyclidium and Uronema, belong to the Ciliata-Holotricha, or to the Ciliata-Heterotricha? The boundary between the two orders is so indistinctly defined that the doubt becomes a serious one.

However, the cilia which have led me into this side issue remain standing, like the sentinels they are, beside the adoral sinus. While the animal is feeding they are not actively vibratile, although the whole row has the power of bending in a body across the groove. I have seen them waving back and forth in an unbroken line like an animated comb. Each member of the group also has the ability of separately bending in a direction away from the median line, and it uses this accomplishment when a food-particle, too large or otherwise unacceptable, must be discarded, several often flirting themselves in unison outwardly when there is too great an accumulation about the oral aperture. When their possessor is swimming they are drawn up against the ventral surface parallel with the margin of the adoral groove, and consequently in contact with each other, their free ends thus pointing posteriorly.

I have found it quite impossible to use the camera lucida in drawing the details of these active little animals. The figures are therefore more or less diagrammatic, with the exception of the first. In the second (Fig. 2) an attempt is made to show the animal in its lateral aspect, with the coarse comb of adoral cilia, the anterior ciliary tuft and the single row of long, laterally-disposed vibratile hairs, as well as the nucleus and the contractile vesicle. In Fig. 3 Ctedoctema exhibits its ventral surface, especially the adoral groove, with the ciliary comb on its margin, laterally curved above it and surrounding its termination posteriorly.

The trichocysts, found, it is said, only in the flesh of members of the Ciliata, are numerous in Ctedoctema, huge in proportion to the size of the infusorian, and possessed of peculiarities not hitherto noticed in connection with those of any other member of the class. The action of the recently-recommended solution of tannic acid in glycerine for the purpose of rendering trichocysts conspicuous, is eminently successful and satisfactory.

When killed by this mixture, Ctedoctema becomes a nondescript object, woolly with distorted cilia, and having trichocysts like great darning-needles projecting from various parts of the surface. They are occasionally so violently extruded that they leave the body and fall away free. The infusorian is $\frac{1}{1000}$ inch in length; the trichocysts are $\frac{1}{2000}$ inch long, precisely one-half Ctedoctema's greatest length, and but a fraction shorter than its transverse diameter. Under suitable amplification they are visible within the living animal. Those of the posterior extremity are arranged nearly parallel with the median line; those of the posterior body half are directed forward, those of the anterior half backward, toward the center of the creature. They are rigid and straight, and, for their length, coarse and stout. They project slightly beyond the cuticular surface and often give the

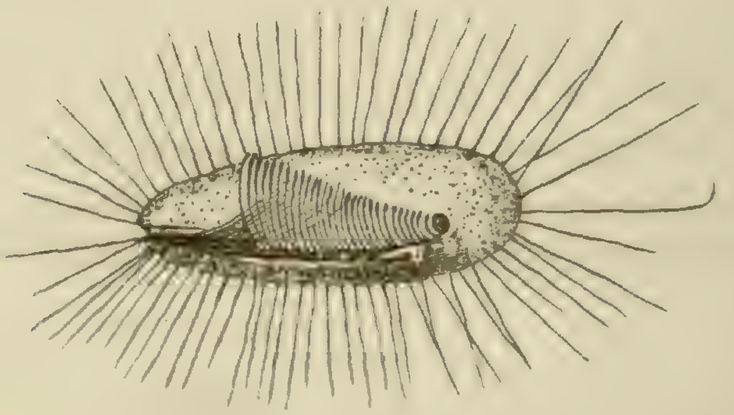

Fig. 3.

Fig. 4.

FIG. 3.—*Ctedoctema acanthocrypta*, ventral aspect. FIG. 4.—Trichocyst with radiating processes.

infusorian, in optical section, a minutely crenated outline. Although so skewered the body is still soft and flexible.

From their distal end they taper evenly to an obtuse point and seem to be prismatic. The structural parts which I think have hitherto not been noticed with those of any other infusorian consist of four, occasionally of only two linear processes radiating from the body of the trichocyst, like the finger-boards on the sign-posts at country cross-roads, as shown in Fig. 4. These projecting filaments, measuring $\frac{1}{10000}$ inch in length, are of extreme delicacy, and take their origin at a distance about equal to one-half their length below the distal extremity of the trichocyst. Their direction is not always at right angles to their support, but frequently, even in those of the same individual, they project upward or downward, or form angles of various degrees.

The oral aperture is not followed by a distinct pharyngeal

passage, and although I have never observed food-particles enter, yet judging from the presence within the sarcode of small green corpuscles, which I have taken to be of vegetable origin, I suppose Ctedoctema is a vegetarian. Neither has an anal opening been distinctly noticed. Upon several occasions what has appeared to be an extrusion of excrementitious matters has taken place posteriorly to the oral aperture and back of the ciliary comb, but the flow of rejected food-particles brought by the adoral currents is so great and so constant, that the question is still an open one.

As to the fashion of its reproduction: Is it as whimsical in its manner of renewing its youth as in its adoral anatomy? In one respect, yes. In one respect it goes about that business in a way to surprise the on-looker who has become familiar with every style of fission and with several varieties of cystic sacs, and in a way, too, that makes him pause a moment to admire the exhaustless resources of a divine mind.

That reproduction is by transverse fission goes without saying. But if only that, imagine, if you can, what becomes of all the complex ciliary arrangement about the oral region. The creature to be fashioned from the posterior half of the mature body must have not only a ciliated adoral sinus and the comb-like appendage, all of which simple division crosswise would give, but it must somehow obtain that ciliary fascicle at the anterior apex of that sinus. The posterior termination of the old Ctedoctema's groove has no such tuft to give the new creature, and the latter cannot, at least does not, exude sarcode filaments that shall stiffen into cilia. Then, when and how? Oh, it is so simple and so easy when it is once thought of! But no one ever would think of it without seeing it.

It is in this way: The cilia of that comb deliberately unite laterally and form a membrane. The anterior cilia of the sinus unite with it and lengthen the membrane to the front, the newly-formed tissue being widest somewhat in advance of its center, and narrowing toward both ends. The animal then separates across the middle, forming two Holotrichous creatures, each with a perfectly smooth, unwrinkled membrane vibrating somewhat obliquely along the center of its ventral surface, the free edge of this tip-tilting tissue being distinctly and strongly thickened. What scheme of classification has a place for them

now? If they and the systematist should have a temporary en counter, what would he do with them? Would each be a fres water Lembus? Such questions give them no trouble. They at once proceed to form their ciliary appendages by splitting o their membrane to suit. The fringes unite to form the membran the membrane divides to form the fringes, the thick edge thu going into the thickened extremities of the adoral comb. In tw hours, more or less, the sweet-water Lembus is a sweet-wat Ctedoctema, of which the following may be taken as a descr tion:

Ctedoctema, gen. nov. (Greek, *ktedon*, a comb; *ktema*, a possession).—Animal free swimming, more or less ovate, persistent in shape, entirely ciliate; oral ciliation verse to those of the cuticular surface; oral aperture ventral, located at the poste termination of a longitudinal, ciliated, adoral depression or groove which bears its right-hand border a row of large arcutely curved setose cilia gradually diminish ing in length toward the oral aperture, which they surround, and with their extremities conspicuously thickened; several long, setose hairs projecting from the posterior extremity of the body, usually a single one being distally curved; contractile vesicle single, posteriorly placed; trichocysts large and numerous.

C. acanthocrypta, sp. nov. (Greek, *akantha*, spine; *kruptos*, concealed).—Body elongate-ovate, widest and rounded posteriorly, tapering to an obtuse anterior apex, subcylindrical, slightly compressed, the length twice to two and one-half times the breadth, a hemispherical sarcode bubble usually present on the left hand lateral border; cuticular cilia long, fine, setose, a single postero-terminal seta distally curved; oral aperture ciliated, remote from the anterior apex, placed at the posterior termination of a shallow, narrowly ovate, ciliated, adoral groove centrally longitudinally traversing three-fourths of the ventral surface, and bearing on its left hand margin a flexible comb-like appendage composed of large, coarse, non-vibratile cilia, thickened distally and diminishing in length as they approach the oral aperture which they surround; the adoral groove also bearing near its left hand margin a row of long, fine, vibratile hairs, and throughout its entire length a series of long, fine vibratile cilia, somewhat fascicled anteriorly and shortening as they approach the mouth; contractile vesicle single, sub-terminally located near the right border, elongate-ovate, mesially placed in the anterior body half; trichocysts large, straight, apparently prismatic, tapering to an obtuse point, and bearing distally two or more minute, radiating, linear processes. Habitat: Fresh water, with Lemna. Length of body $\frac{1}{1000}$ inch.

The animal was studied with a homogeneous immersion $\frac{1}{16}$ by Herbert Spencer, N. A. 1.35, and a homogeneous immersion $\frac{1}{12}$ by Bausch and Lomb, N. A. 1.43, two objectives which are real works of art.

THE THEORY OF SEX AND SEXUAL GENESIS.

BY C. M. HOLLINGSWORTH.

IN sexual genesis the germinal aggregate with which the development of the new individual begins is the product of the union of two generative cells. One of the combining cells—the female element, or germ-cell—is a very large one; while the other—the male element, or sperm-cell—is a very small one. Their union is effected by the sperm-cell, or its generative matter, penetrating into the body of the germ-cell; and the former loses its identity and integrity as a cell in the act of union, while the latter does not. Sexual genesis, in its initial stage, is thus a dual process, consisting in the coöperation or combined action of two factors, and these factors are comprised in the contents of generative cells that are morphologically distinct.

The fundamental problem in the theory of sexual genesis, with regard to the physiology of the process, is this: Are the two factors of the process represented in these two classes of morphologically distinct generative cells likewise functionally distinct, and complementary the one of the other? And, if so, What are the physiological differences between them, and what the need and rationale of their observed mode of coöperation in the generative process?

Besides explaining the physiological differences and relations to each other of the male and female generative elements, an adequate theory of sex and sexual genesis must also explain the correlated morphological and functional differences between male and female organs or organisms.

The Advantage of Genesis by Germ-cells.—The development of an individual organism may begin with the contents of a single generative cell, which may or may not be the product of the union of two cells, or it may begin with a bud or gemma composed either of an aggregate of untransformed cells or of portions of partially differentiated tissues. Leaving out of consideration for the present the fact that in sexual genesis the original contents of the germ-cell requires impregnation by a sperm-cell in order to enter upon the normal developmental changes, I wish here to point out that the former mode of the origin of new individuals gives an important advantage in the perpetuation of species, so far as perpetuation depends on the production of a great number of off-

spring. The explanation of this advantage may be given as follows: In order that a germinal aggregate may develop into a distinct individual, with a due coördination of its parts about a distinct axis or center, the formative conditions within it must first be, in some manner and to a great extent, isolated from the formative conditions in the parts of the parent-body in connection with which its production as an aggregate has taken place, otherwise its unity of development as a distinct individual would be interfered with, or we may say would be impossible. For this reason the size which a bud is required to have in order to enter upon an individual development is much greater than the size which a germ-cell is required to have. This follows from the manner in which a bud is formed. In the simplest case for multicellular organisms, a bud is formed by the outgrowth by cell-multiplication of an aggregate of cells from a layer of undifferentiated cells of the parent body. Thus in the first stages in the growth of the bud, both the cells which compose it and the cells of the layer from which it is produced, must be in a plastic formative state in order that the growth of the bud in this manner may go on. And the isolation that is requisite to its distinct individual development is only brought about by sheer outward growth away from the producing cell-layer. That is, the bud must necessarily, from the mode of its formation, attain considerable dimensions before its independent development can begin.

On the other hand, where the development begins with the contents of a single germ-cell, the requisite isolation of the formative conditions within it is brought about, not by growth in size, but by the germinal mass becoming inclosed by a distinctly differentiated cell-wall, or capsule, or embryo-sac. And thus, as in the higher plants, we find that the first stages in the development may take place with the new individual completely inclosed on all sides with tissues of the producing organism in which vital processes are actively going on. This surrounding tissue itself forms a small bud, but one of low organization and generally much smaller than any bud that is fitted for functions of self-maintenance. The eggs of animals in like manner become isolated in their formation, but are discharged from the producing organ before their development begins.

In consequence of these relations an immensely greater number of seeds or eggs fitted for a complex development can be

produced by a plant or animal than of bulblets or gemmæ. Moreover, when produced they are better adapted for dispersal, in the case of seeds, to suitable situations for their growth; and in the case of eggs, may be deposited in favorable situations by the producing animal.

This advantage of genesis by germ-cells over genesis by the production of buds, obtains in all the lower grades of organisms in which the perpetuation of species depends, to a great extent, on the production of a large number of offspring. For the higher animals, or for all terrestrial animals, there is the further consideration that the large buds which they would have to produce, and the mode in which they would have to produce them in order to keep up the succession in this way, would so encumber the producing organism as greatly to lessen its powers of self-conservation. As a matter of fact we do not find any terrestrial animal reproducing by buds. The highest aquatic animals that do so are the Tunicata or Ascidians. In these the buds are produced from a large stolon, which the medium in which the animal, or associated group of animals, is supported, enables it to carry with it without any great interference with its self-conservative actions. Besides, in the aquatic mode of life the whole body may be soft, and that high degree of differentiation of the tissues is not required, at least in all cases, that is required in terrestrial animals. But all animals and plants, except the lowest, that reproduce by the formation of buds, also reproduce from germ-cells. In such cases, to whatever advantages the former mode of genesis has in keeping up the succession, is added the advantage, here pointed out, which attends the latter mode.

The Rationale of Sexual Genesis.—Admitting that there is an advantage, of the kind above explained, attending genesis by germ-cells, in the perpetuation of species, the further question arises, of what the advantage or need is of the addition to the original contents of the germ-cell of the matter of a sperm-cell, in order that the single mass may be fitted to initiate the development of a new individual. No doubt a considerable advantage results from crossing. But crossing does not always take place in sexual genesis. Besides, to assign this reason is not to give a fundamental explanation. It leaves the physiological difference between the two kinds of generative cells to be determined, and the requirements of the formative and developmental processes to be assigned which makes this difference necessary.

The germ-cell and the sperm-cell cannot be regarded as physiological or generative equivalents—leaving out of the account for the present their morphological characters. They are physiologically differentiated, though not specialized in the sense in which the component cells of the various tissues are specialized. It is the function of the cells of each of the different kinds of tissues as specialized cells, to form or secrete from substances derived from the general plasma of the organism, some organic compound of specific constitution, which is either deposited in contact with the protoplasm of the cell as a solid or semi-solid component part of the structure of the tissue, or is thrown out as a liquid secretion by the bursting of the cell-wall. The functions of the two kinds of generative cells are not such that their differentiation from each other could be of a nature to render them specialized in this sense. But since the office of sexual genesis consists in the production of organisms as wholes, and not merely of limited parts of organisms, we may fairly infer that in so far as the developmental process in general can be analyzed into two essential factors, it is these two factors which constitute the organic basis of the dual character of the function of sexual genesis, and therefore that it is with reference to these two factors of the process that the two kinds of generative cells have been differentiated, and not with reference to special products of the process. Two such general factors are commonly distinguished by biologists as comprised in and making up the whole process of development, namely, growth and differentiation. Or since cell-division is the basis of differentiation, we may say that in the more strictly formative stage in the development of an organ or tissue, the two factors are cell-growth and cell-division. Hence the presumption on general grounds is, that one kind of generative cells represents one of these factors, or results from differentiation in the direction of one of these factors, and the other kind represents the other factor.

The facts sustained this presumption, and at once indicated in which kind of generative cells each factor in an excessive degree belongs.

Germ-cells attain a greater size than any other formative cells. Says Professor Minot: "It is a rule, no exception to which, I believe, is known, that the mature egg-cell is much larger than any other cells in the body of the parent" (AM. NATURALIST, Feb.

(880) On the other hand, sperm-cells are among the smallest cells of the producing organism. Mature germ-cells result from the extraordinary growth without division, of certain of the primitive germinal cells of the ovary, generally with the aid of the formative activity of other smaller cells by which they are surrounded. In animals "the spermatozoa are formed by the breaking up of the male germinal cells, or of cells secondarily derived from them by division. The cells which directly give rise by division to the spermatozoa may be called spermospores, and are equivalent to the ova or oöspores" (Balfour, Comp. Embryol., Vol. I, p. 53). Pollen-grains in like manner are produced by the subdivision of a mother-cell. In all except "the lowest forms of vegetable life * * * the two cells that take part in the act of sexual union * * * are strikingly different in size, form and physical properties. In these cases one of the two cells, the male cell, conveys to the other only a small quantity of material by means of which it produces an effect upon it; this other cell, the female cell, contains by far the largest proportion of the material which takes part in the development incited by the act of union" (Sachs, Botany, p. 224).

Thus in the production of germ-cells there is evidently a relative preponderance of the factor of growth; and in the production of sperm-cells there is a relative preponderance of that factor of the developmental process which is more especially concerned in cell division.

We have next to inquire why this relation or differentiation between the two kinds of cells should be necessary to their cooperation in the initiation of a complex development.

A germinal aggregate which is fitted to initiate the development of a complex organism must be an aggregate of considerable size, in order that it may afford an adequate basis for the incipient formation of the different parts. The production of such an aggregate can only take place on condition of the absence of a tendency in it to undergo segmentation, and thus enter upon developmental changes while it is yet small. It must be so constituted and so placed that there is a relative deficiency of the factor of cell-division in the formative processes by which it is produced. Then, when it has attained the requisite size, it is still unfitted for active development until this deficiency is supplied, and the proper balance between the two factors is restored.

This result is brought about by the accession to it of a sperm-cell, which represents a relative preponderance of the factor of cell-division, and the development is then begun with that degree of energy which is necessary to insure its going on to completion. In every species of organisms a certain mean adjustment of these two factors to each other is suitable to the formation of organs and tissues having the requisite structural characters, after the first stages of the development have been passed through. In the germ-cell there is a departure from this mean standard of adjustment in one direction, and in the sperm-cell a departure in the opposite direction; the departure in the one case being necessary to the formation of a single aggregate of sufficient size to serve as the basis of the development, and the departure in the other case being necessary to the formation of germinal matter fitted to restore the balance by its union with the larger aggregate. This I believe to be the fundamental principle in the theory of sexual genesis.

But in parthenogenesis the germ-cell undergoes development without impregnation by a sperm-cell; and at first it may appear that the theoretical conclusion here arrived at is irreconcilable with this fact. It may be shown, however, that it is not. In the first place, parthenogenetic eggs or germ-cells are generally smaller than eggs that require fertilization. In the second place, whether they are smaller or not, the individuals developed from them do not generally if ever attain to as high a grade of organization as those developed from impregnated germ-cells. So conspicuously is this the case in plants, that Sachs bases his interpretation of the phenomena and advantage of sexual genesis on this observed difference. In the third place, the normal balance between the two factors of the developmental process may be restored in the germ cell, but not so completely, in other ways, besides impregnation by a sperm-cell. This may result from a freer access of oxygen to it after it has been discharged from the producing organ; by its absorption of water, with other matters in solution, which have a tendency to set up active changes within it; or by its being subjected to a higher temperature than that at which it was kept during its formation. By one or another of these changes of conditions the balance may be sufficiently restored to cause the development to go on; but not so completely restored as it is by the accession to the germ-cell of a

germ-cell, in addition to changes in some of the external conditions here mentioned. And in sexual genesis there is the further difference that whatever advantage there is in crossing, or in the union of two portions of germinal matter derived from different sources, is also secured.

The Redundant Sexual Type.—In the early stages of embryonic development in the higher animals no distinction as to sex is apparent even in the sexual organs. Having regard to this fact, the view which had come to be generally accepted among physiologists, before the advent of Darwin's theory, with respect to the morphology of the sexes, was, that there is a common type for all the individuals of both sexes in a species. But by most physiologists this type was not believed to be hermaphroditic. "The early type of the sexual organs is to be regarded as common and single rather than double, as some have considered it" (Allen Thomson, Todd's Cyclop., Vol. II, 1839, Art. Generation). In the article on hermaphroditism in the same work, Simpson asserts, as he says, "the opinion commonly received by physiologists of the fundamental unity of sex among all individuals belonging to the higher animals; or, to express it otherwise, we have assumed that each individual is, when normally formed originally furnished with elemental parts capable of forming one set of sexual organs only." Still he refers to the rudimentary sexual organs in each sex as analogues of developed organs in the opposite sex. The most familiar and striking examples we have of such rudiments are the rudimentary mammæ in male mammals and the clitoris in females.

When Darwin adduced the existence of rudimentary organs as evidence in support of the theory of descent, and as facts that are inexplicable on any other theory, he made no distinction between rudimentary sexual organs and rudiments of organs that pertain to individual self-maintenance. The only possible or reasonable explanation of the existence of the latter is that they are reduced representatives of organs that were functional in the ancestors, in some former period, of the organisms of the present time in which they are found. And the same explanation was applied by Darwin to the rudimentary sexual organs—which explanation has generally been adopted by his followers. But against this explanation in the case of the sexual rudiments two valid objections may, I think, be made. In the first place, none of the

highest animals of the present time are functional hermaphrodites. Says Gegenbaur: "The hermaphrodite stage is the lower and the condition of distinct sexes has been derived from it. The change is due to the decrease in size of one or the other organ so that hermaphroditism is the precursor of sexual differentiation. This differentiation, by the reduction of one kind of sexual apparatus, takes place at very different stages in the development of the organism, and often when the sexual organs have attained a very high degree of differentiation. In these cases ontogeny exhibits the two kinds of organs primitively united and so causes the individual to be hermaphrodite at a certain stage of development" (Compar. Anat., Eng. ed., 1878, p. 54). But this general hypothesis becomes inconsistent with the facts when carried out in its application to the higher vertebrate animals. For in the highest animals that the most perfectly formed rudiments are found, in each sex, of the sexual organs that in their developed or functional state are proper to the opposite sex alone. If they are reduced representatives of organs that were once functional, those organs must have been functional in animals of the same grade and type as those in which the rudiments are now found; otherwise the rudiments would not be the exact analogues or reduced representatives which they are, of the functional organs at the present time of the opposite sex. And no physiological reason can be assigned why animals in other respects of the same type and grade of organization, which are best fitted to perpetuate their species by a complete functional differentiation of the sexes, at the present time, should have been better fitted to do so as hermaphrodites at a former period. In the second place, the whole morphological type of the reproductive organs of either sex in any species of the higher animals, comprising both rudimentary and developed sexual organs, does not make up a full complement of the developed sexual organs of both sexes. Referring to the higher animals, Simpson says: "The hermaphrodite was defined by the ancients as an individual capable of fulfilling by turns the reproductive functions of both sexes, or at least one who simultaneously possessed both the male and female organs fully developed; such a being, however, is not only unknown among the authentic details of anomalies, but is physically impossible in man and the higher orders of animals without extensive alterations in the connections of the bones and

ther parts of the pelvis. "The type of development [from common embryonic parts] of the genital organs may be stated to differ in the different parts of the system in the two sexes as follows:

"1st. It is single and homological in the external organs.

"2d. It is double and heterological in the middle organs or passages.

"3d. It is partially double and heterological in the productive organs." (Quain's Anatomy, 1876, Vol. II. p. 814.)

The morphological sexual type of either sex comes thus short of comprising a complement of the developed organs of both sexes, owing to the fact that for some of the organs, or parts of the sexual apparatus, the same primary tissue develops into a male organ or part, in one sex, and into a female organ or part in the other sex. But the common fundamental type of the species is redundant as to the number of organs required to be developed in either sex alone, owing to the fact that for some of the organs the same primary tissue that is required for functional parts in one sex, cannot be converted into functional parts in the other sex. In the higher animals, therefore, the normal development of each male or female individual is a one-sided development of this sexually redundant type, and not a one-sided development of an embryonic hermaphrodite.

Thus much premised, two questions of theory have to be answered in order to make all the phenomena of sexual development intelligible. We wish to know why it is that useless rudiments appear in one sex of organs that are only required to be functional in the other sex; and we wish to know how it is that, though in rare cases, each individual, presenting at first the common embryonic type of the whole species, afterward undergoes complete development in the adult sexual characters of one sex only of the other sex alone, and does not take an intermediate course of development between the two adult types.

In order that a germ-cell and a sperm-cell may effectively unite in the initiation of the development of a new individual, there must be an approximately complete correspondence between them as complementary factors of the single course of evolution. There are two conceivable ways in which individual organisms might be produced having the necessary sexual organs of either sex alone fully developed, without rudiments of those that are functionally proper to the other sex being formed. One way

would be for each female parent organism to produce two kinds of ova or germ-cells, one kind fitted to initiate the development of male, and the other the development of female offspring, while each male parent organism produced two corresponding kinds of sperm-cells. The other way would be for only one kind of ova and one kind of sperm-cells to be produced in a species, but for each embryo to be deflected to a one-sided development—that of one of the sexes—so early and so completely that no perceptible rudiments of the sexual organs proper to the opposite sex should at any time be formed. The first method is evidently too complicated ever to be established and maintained in any species by natural selection, at least without some great advantage in the perpetuation of the species could be gained by it that could not be secured in any other way. The second method is actually exemplified in a great many of the lower monosexual organisms, where the requisite sexual organs consist simply of an ovary or pistil in the one sex and a testicle or anther in the other. In these no persistent rudiments of the organs of the opposite sex are perceptible in individuals of either sex. But in the higher animals, where a complicated apparatus in intimate correlation with the other parts of the body is required in each sex for the performance of its part of the reproductive function, so early and complete a deflection of the course of development with respect to these organs, cannot take place. A certain set of sexual organs of the sexually redundant type must be developed to a functional state in each sex; and the intimate structural connection and functional coördination with the other parts of the body demanded in the efficient performance of their functions makes it necessary that their development be initiated at an early stage in the development of the embryo. But an organism of great complexity can be evolved only on condition that the parts of the embryo shall not become highly differentiated in the early stages of the evolution—on condition that the various parts of the forming body retain for a considerable time their plasticity. In its early stages, therefore, the embryo, considered as a conditioning apparatus of its own formative processes, is necessarily unfitted to have established, or maintained within it, so sharp a differentiation of the conditions of those processes, as affecting the development of the sexual organs, as would be necessary to cause those organs that are functional in either one of the sexes only to enter upon a complete development, and at the same

time cause the development of the organs that are redundant to that sex to be so completely arrested that not even rudiments of them should appear. This explanation agrees with and also explains a law of variation enunciated by Darwin, namely, that "variations which appear early in life in either sex, tend to be developed in both sexes" ("Descent of Man," p. 232).

The existence of rudimentary sexual organs is thus, I think, satisfactorily accounted for, without assuming that they represent organs that were once functional in the sex in which they are found. In the course of descent of a species it is the common type of the species—which is redundant as regards the organs that are required to be functional in either one of the sexes—that undergoes modification by adaptive variation, and by the natural selection of irrelative variations through the succession of the best reproducers. Those organs of the redundant type that are functionally proper to either one of the sexes have their characters determined by natural selection acting within that sex. But if, owing to the conditions above explained, a developed organ in one sex is represented by a rudiment in the opposite sex, any modification of this part of the common type will not only appear in the developed organ of the one sex, but also and correspondingly in its rudiment in the opposite sex. Thus, for the higher animals at least, the rudimentary sexual organs are to be regarded as having been acquired *as rudiments* in the sex in which they are found, and not as representing organs that were once functional in that sex. This explanation accords with the fact that such rudiments are most perfectly formed in the highest animals, where the developed sexual organs themselves attain the highest degree of organization as specialized parts.

No doubt there are cases among plants in which the reproductive individuals, or members of a composite individual, are now unisexual, and possibly among the lower animals also, where rudimentary sexual organs do represent organs that were functional at a former period, when the species was hermaphrodite. But in many cases it would be difficult to determine whether the actual course of modification by which the present reproductive type of the species has been reached, has been by the reduction of organs that were once functional to a rudimentary state, or by the acquisition of the rudiments as parts of the common reproductive type of the species.

(To be continued.)

ON THE EVIDENCE THAT THE EARTH'S INTERIOR IS SOLID.

BY DR. M. E. WADSWORTH.

(Continued from page 594, June number.)

The Evidence of the Earth's Solidity derived from the behavior of matter under the combined action of Heat and Pressure.—The key-note of this problem was given by Mr. William Hopkins in stating that if the tendency of the temperature to liquify the interior portion of the earth increases more rapidly than the pressure tends to solidify it, that interior would be in a state of greater or less perfect fluidity; but if the tendency to solidify from pressure is greater than the tendency of the temperature to prevent it, the earth would solidify from the center. In other words, whether the earth's interior is solid or not, depends upon the relative increase of the temperature and pressure, and on the behavior of the earth's materials under increased heat and pressure. Some experiments were made by Hopkins to ascertain the relation of solidity and fusion under the combined influence of heat and pressure on certain substances. He found that for spermaceti, wax, sulphur, and stearine as the pressure increased the point of fusion was raised, but irregularly, and with a diminished ratio, while metallic alloys showed no elevation of the fusion point. He did not regard his experiments as satisfactory, particularly those on the alloys.[1]

The subject was later discussed by Sir William Thomson, who held that from the "thermo-dynamic law of his brother, James Thomson, the earth must have solidified from the center outwards. This law asserts that all materials which contract on congelation have their melting point raised by pressure, while bodies that expand on freezing have their melting point lowered by pressure.

This law was experimentally verified by Wm. Thomson in the case of water. Hence, accepting Bischof's experiments as correct which indicated that the earth's materials contracted from ten to twenty-five per cent on solidification, Thomson claimed that even if the internal heat was very great, the pressure would increase more rapidly than the tendency to liquify, and hence the earth must have a solid center.

The discussion then rests largely on the question of fact: Do

[1] Report Brit. Assoc., 1854, XXIV (Sect.), 57, 58; see also Bunsen, Ann. Physik Chemie, 1850, LXXXI, 562–567.

the earth's materials contract or expand on solidification? Mousson experimented further on the action of water according to James Thomson's law, and showed that it required enormous pressure to lower the melting point of ice a few degrees.[1]

So far then as any conclusion can be drawn from these experiments, it would show that the pressure must increase to an enormous amount to keep pace with the supposed increase of heat—a pressure that the earth's specific gravity negatives.

It can well be claimed that the known rate of the elevation of temperature, as the interior is approached, far surpasses the known rate of change of the fusion point by pressure in the few cases investigated.

David Forbes has further pointed out that, since the substances mainly experimented upon by Hopkins and Bunsen are not, except sulphur, components of the earth, experiments made with them do not necessarily apply to the materials of which the earth is composed. He also suggested that if the pressure is raised to great heights the reverse may be true regarding the effect of pressure on the melting point—it may lower instead of raise it. He also thought that we should look rather at the results obtained by Hopkins from the alloys instead of those from the wax, etc.[2]

In discussing the state of the earth's interior, Dr. T. Sterry Hunt advanced the argument that the material of the earth, when in its former fused state, would solidify from the center on account of the congealed mass being much heavier than the liquid: "We may say in a few words that the process of cooling in a mass like this would be just like the cooling of a great bath of metal or of sulphur; in other words, the condensation or congelation would commence at the center and extend outward toward the surface, so that the temperature of the center would therefore be the temperature of congelation."[3]

David Forbes, in reply to Dr. Hunt's argument, very pertinently remarked that no one "had ever seen a mass of metal or sulphur crystallize or solidify in the interior first, since the interior of such masses, it is well known, remain liquid after the

[1] Ann. Physik Chemie, 1858, CV, 161–174; Everett's Deschanel's Natural Philosophy, 1872, pp. 312, 313; 1883, pp. 331, 332.

[2] *Pop. Sci. Rev.*, 1869, VIII, 121–130; *Geol. Mag.*, 1867 (1), IV, 431–444.

[3] *Geol. Mag.*, 1877 (1), IV, 357–369.

crust has formed upon the surface; and furthermore, that the crust always remains upon the surface and does not sink."

He also remarked that "a crust of the specific gravity of 2.6 cannot sink deep down into the fluid mass of a globe possessing the mean density of 5.3."[1]

In looking over the data for the assumed contraction of the materials forming such portions of the earth's crust as we are able to examine, it will be seen that the early experiments of Bischof indicated a contraction in passing from the liquid to the crystalline state for basalt of some ten per cent, of trachyte eighteen per cent, and of granite twenty-five per cent; or tabulating the results, we obtain, according to David Forbes:[2]

	VOLUME.		
	Fused.	*Glass.*	*Crystalline.*
Basalt	1000	963	896
Trachyte	1000	888	818
Granite	1000	888	748

The question of the contraction of igneous rocks in cooling was further taken up by David Forbes,[3] although none of his observations appear to lead to any more definite conclusions than that Bischof's results were much too high, and that his work was too crude to be of any great value.

In a later paper Forbes pointed out that in nature there was no evidence of a contraction of from one-tenth to one-quarter of the volume, such as Bischof had held, when the rocks in the form of dikes, etc., were studied *in situ*—a statement that probably every petrologist will sustain.[4]

Some further experiments on the contraction of siliceous materials in cooling were made by Robert Mallet. He claimed that the result showed "that the difference in specific gravity, less than that between ice and water, between red-hot but solidified or even cold slag (or analogous fused rocks) and the same in liquid fusion, is so slight that, coupled with the viscous or pasty condition which intervenes between the two states, it would readily admit of a thin or a thick terrestrial solidified crust being supported by and upon the surface of the liquid globe beneath, and

[1] *Geol. Mag.*, 1867 (1), IV, 431–444; *Chemical News*, 1868, II (Amer. reprint) 110–113.

[2] Neues Jahr. Min., 1841, pp. 565, 567; 1843. pp. 1–54; *Chemical News*, 1868, XVIII, 191–194.

[3] *Chemical News*, 1868, XVIII, 191–194.

[4] *Geol. Mag.*, 1870 (1), VII, 1–4.

lends no support to the view of terrestrial consolidation at the center first, by continual subsidence of such crusts, as imagined by Poisson, nor to the notion as to the nature of volcanic action which Sir W. Thomson has based on that assumption. * * * We * * * may be permitted to conclude that rocks consisting of acid silicates contract still less than those of basic silicates, and that a terrestrial crust of the former is still more capable of floating upon the same in fusion beneath."[1] However much Mr. Mallet's views may agree with those of the present writer, it is but just to point to the fact that the slags experimented upon differ essentially from basaltic rocks, and it is not permissible to assume that one certainly gives the law for the other, however probable it may be that they act alike under similar conditions. This also applies in less degree to Mallet's comparison between plate glass and the rhyolites.

Further studies were made, in 1874, by Mr. Mallet on the alleged expansion of various substances on solidification. His experiment of filling a conical wrought iron vessel with molten iron seemed to show that liquid iron when heated far above its melting point has a specific gravity of 6.65, while the same iron in the cold state is 7.17. Mallet claims, therefore, that cold cast-iron is always heavier than molten iron. It is to be observed that no comparison was made between iron near the melting point and the same when just above that point.

He further tried some experiments regarding the flotation of solid iron upon molten iron, which must be regarded as conclusive upon that point. In all cases the iron either did not sink, or if when first immersed it sank, it afterwards rose again. Mallet says: "A piece of cold cast-iron which floats on liquid iron of its own quality, if forcibly thrust to the bottom and rapidly and at once released, rises again rapidly to the surface with all the *appearance* of a *buoyant* body, which it certainly cannot be."

The same experiments made with lead showed that it always sank when immersed in the molten lead. In this case when flat pieces were carefully laid upon the fluid lead they floated until the equilibrium was disturbed, so that the fluid could wet the upper surfaces when they sank. This flotation of the lead seems to be a case of the same kind as the flotation of a needle upon water. Mr. Mallet endeavored to explain the phenomena in the

[1] Philos. Trans., 1872, pp. 147–227.

case of iron and lead by the assumption of a repulsive force, much the same kind of explanation as "Nature abhors a vacuum," for here the repulsion exists for iron but not for lead. He seems to have lost sight of the true problem before him: Is solid metal at or near the melting point of a greater or less specific gravity than the same metal liquid at or near the point of solidification, and substituted for it the question is cold solid metal heavier or lighter than the same metal when heated to *any* temperature above the melting point. Surely the tendency of most bodies to expand on the application of heat would, in the case of iron and rocks, cause the difference between the cold solid and the liquid states, to be greater than it would be between the hot solid and the liquid states, a point that does not seem to have been properly appreciated in discussions of the earth's structure. Mallet's experiments show clearly that iron near the point of fusion is lighter than the same when melted, but that lead is heavier. He calls attention to one very important point: That owing to the difference in specific gravity in the various grades of cast-iron, it is necessary that in these experiments the liquid and solid should be of the same quality, otherwise real buoyancy or the reverse may occur from this cause. Mallet further seems to admit that liquid slag will allow solid slag to float upon it, either on account of a certain vesicularity, whatever care may be taken, or on account of his hypothetical repellant force.[1]

Some other experiments were made by Centner, W. J. Millar and Joseph Whitley.[2] The general result of these would be to show that cold steel, iron, brass and probably slag will sink in the same material when molten, but when hot and solid they become lighter and will float; also that lead and perhaps zinc possess a higher specific gravity when solid, whether hot or cold, than the molten metal.

In 1875 Mr. W. C. Roberts made some experiments by Mallet's method, on the density of silver in the cold state and in the molten condition. These showed that it was more dense in the former than in the latter state.[3]

[1] Proc. Roy. Soc., 1874, XXII, 366–368; 1875, XXIII, 209–234; *Nature*, 1874, X, 156, 157.

[2] *Nature*, 1877, XV, 529, 530; XVI, 23, 24; 1878, XVIII, 397, 398, 464. Whitley's experiments are erroneously credited to Muirhead in Dana's Manual of Geology, 1880, 3d ed., p. 810.

[3] Proc. Roy. Soc., 1875, XXIII, 349, 350, 481–495.

Sir William Thomson in 1878 again took up the discussion of the earth's solidity, based on the assumed greater density of the solid than liquid rock. He seems at that time to have only been aware of Bischof's experiments, but in a note subsequently added by him, Whitley's experiments appear to be accepted as decisive against his views. Starting with the, to him, probable supposition that the solidified crust of the earth would sink towards the center, Thomson says: "As soon as the surface began to freeze, and to freeze in sufficient quantity not to be floated up by mere superficial solidified foam, the mass of rock would fall down towards the center. More would then solidify at the surface. This also would fall down, and the same thing would go on again and again. Gradually a sort of honey-combed solid would be formed. By-and-bye [*sic*] a skeleton or frame-work through the whole would mount up to an extent sufficient to build up piers, as it were, to the surface, and the spaces between these piers, when close enough, would, in the continued freezing of the lava, be bridged across by solid rock thick enough in proportion to breadth not to break down and sink. There would, again, be breaking away of the piers and upheavals of the liquid material below; but by degrees the honey-combed mass would become nearly like a solid throughout with comparatively small interstices of liquid lava. * * * The conclusion to be drawn respecting the internal condition of the earth is, that we are not to infer liquidity of the interior, even if we should find evidence of a much higher internal temperature than that which would melt the rocks under ordinary pressure."

The interior heat, Thomson states, "may be 4000° F., or 5000°. It may possibly be 8000° or 10,000°."[1]

In 1879 investigations were made by Messrs. J. B. Hannay and Robert Anderson on the expansion of cast-iron when solidifying. The chief method used was the flotation of a sphere of cast iron in a molten bath of the same. The latter was cooled near to the solidifying point and then the solid spheres dropped in. "They were found to sink at once when dropped in cold, and they remained under the metal till they had acquired a temperature just approaching visible red; but at that temperature they rose to the surface, and as they gained more and more heat from the liquid metal, their line of flotation rose higher and higher. Some-

[1] Trans. Geol. Soc. Glasgow, 1878, VI, 38–49.

times, if dropped in suddenly, the spheres did not float until they had begun to melt, but this was owing to their having cemented themselves to the bottom of the pot. When dropped in cautiously, or suspended by a wire, they sank only for the space of twenty to twenty-five seconds, and rose to the surface when barely red hot."

These experimenters found that liquid cast-iron expands at least 5.62 per cent of its volume in solidifying. A result that they regarded as under the truth, since the maximum density of the molten iron seemed to be little if any above the melting point, while they were obliged to use it at a temperature above the point of maximum density.[1]

Experiments upon the relative volumes, solid and liquid, of tin, lead, zinc, bismuth, cadmium, antimony, iron and copper have been made by Nies and Winkelmann. These show that tin, zinc, bismuth, antimony, iron and copper in passing from the fluid to the solid state expand; that is, if both the solid and liquid densities of the metals are compared when both are at a temperature near the melting point, the solid has the less specific gravity. Hence these metals when hot and solid would float on the liquid, and pressure, according to Thomson's law, would lower their fusion points, thus they would remain liquid at a lower temperature in the earth's interior than on its surface,[2] a fact which may assist in explaining the eruptive origin of some iron ores.[3]

Further experiments by Messrs. Roberts and Wrightson on bismuth and iron showed that "iron expands rapidly (as much as six per cent) in cooling from the liquid to the plastic state, and then contracts seven per cent to solidity, whereas bismuth appears to expand in cooling from the liquid to the solid state about 2.35 per cent.[4]

From the above detailed experiments and observations it is rendered quite clear that the chief portion of the metals expand in passing from the liquid to the hot solid state, both having their density taken near the melting point. That this is the case with the rocks, also, there seems but little doubt, although further

[1] Proc. Roy. Soc. Edin., 1879, x, 359–362.

[2] Sitz. Akad. München, 1881, pp. 63–112.

[3] Proc. Bost. Soc. Nat. Hist., 1880, xx, 470–479.

[4] *Phil. Mag.*, 1881 (5), xi, 295–299.

careful experiments are needed. Practically this seems to be the case in nature of the Kilauea lavas at least.

The question which now presents itself is: What are the probable components of the earth's interior?

So far as can be told from petrographical study, it appears probable that the portion of the interior mass lying nearest the center, concerning which we have any data, is composed of iron[1] either with or without nickel. As we recede from the central portions pyrrhotite is united with the nickel and iron. Then these minerals are found united with olivine or olivine and enstatite in varying proportions, until a portion is reached composed almost entirely of one or both of these silicates, with or without diallage. This portion passes on into the common basaltic rocks, then into the andesites and so on outward into the trachytic, rhyolitic, and jaspilitic forms.

However true this order may be for the liquid earth, that is, the liquid material would form rocks of this character, it is certain that in the solid portions these materials are interlaced now with one another in every conceivable way, and in the chemical and sedimentary deposits they have now been intimately mingled.

What may be the composition of the earth's mass nearer the center, if there be any, besides the iron and nickel, we have no clue, except that it may be some of the rarer elements now found mixed with the iron.

Now, while we know experimentally almost nothing of the behavior of such materials, as probably compose the earth's interior, under the combined action of heat and pressure, it seems most probable, from Thomson's "thermo-dynamic law" and the experiments on their relative hot solid and liquid densities, that the pressure to which they are subject would cause them to liquify at a lower temperature in the earth's interior than on its surface. It may also be justly claimed that if the earth's interior is solid, its liquefaction may be brought about by an increase instead of a diminution of pressure. In this way a sinking area loaded with sediments might thus liquify the rock beneath it. Is this not as consistent a view as the theory of liquefaction through the removal of pressure?

[1] Whitney's Metallic Wealth of the United States, 1854, p. 434, Judd's Volcanoes, 1881, pp. 307–324.

The best test of the relations in density between molten and solidified rock is apparently to compare the density of the rock just before fusion, or at least near that point, with the density of the same rock after melting. This would give a comparison between the crystalline and liquid states, while the usual method only affords a comparison between the liquid and the glassy or semi-glassy states. It would also save any error arising from cells in the cooled rock, if a solid mass was chosen in the first place. Again the fresh unaltered varieties of a rock should be chosen instead of such old and altered ones as those usually experimented upon.

In all discussions relating to the question of the liquidity of the earth's interior, it is to be borne in mind that the chief portion of our knowledge of the properties of liquids is derived from the study of water, a mobile liquid—while liquid rock, as lava or melted iron, is viscous, and its laws and properties may on experiment be found to differ considerably from those of water under like conditions. Also in these solids the passage from the solid to the liquid state or the reverse is not abrupt as is the case with water, for every grade of viscosity exists between the normal solidity and the approximately perfect liquid condition. This is especially the case with iron and seems to be so for the common rocks.

(*To be continued.*)

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THE TERTIARY MARSUPIALIA.

BY E. D. COPE.

SINCE Cuvier discovered an opossum in the gypsum of Paris, the knowledge of the Marsupials of the Tertiary periods of Europe and North America has been gradually extended. In Europe they have been traced to the Middle Miocene, when they disappear from that continent. In North America we know them from Oligocene beds (White River), when they disappear, and are only known as yet thereafter as members of the existing fauna. Descending the scale we have them in the Laramie in America and Jurassic in America and Europe, and in the Trias in South Africa. Whether the Triassic Mammalia of the northern hemisphere belong to this order or not is uncertain. Under the head of Creodonta[1] I have discussed the marsupial resemblances of

[1] NATURALIST, March, April and May, 1884.

that division of Eocene mammals, showing that although their dentition is sometimes that of the carnivorous division of the marsupial order, they cannot be placed with them.

The extinct marsupials belong to three types, as distinguished by the form of their superior molar teeth. These are tritubercu-late, quadrituberculate or multituberculate. To the first division belong the carnivorous types, or Sarcophaga of Owen; to the second the kangaroos and the wombats, to which Owen's name of Poephaga may be applied.[1] The third division is entirely extinct, and is characterized by having at least three longitudinal series of tubercles in its superior molar teeth. To this suborder I apply the name of Multituberculata. The suborder Sarcophaga includes the opossums, and in North America the single extinct genus Peratherium [2]Aymard. This is also the genus which is found in the Oligocene and Miocene of France. It differs from Didelphys (the true opossum) in the non-inflection of the angle of the mandible. Otherwise the two genera are very similar, agreeing in the number (eight) of the inferior incisor teeth. Five species have been found in the White River beds of Colorado. The largest of these, *P. fugax* Cope (Fig. 1), had the skull as large as that of a mole (*Scalops aquaticus*). The smallest, *P. huntii* Cope, does not exceed a small shrew in dimensions.

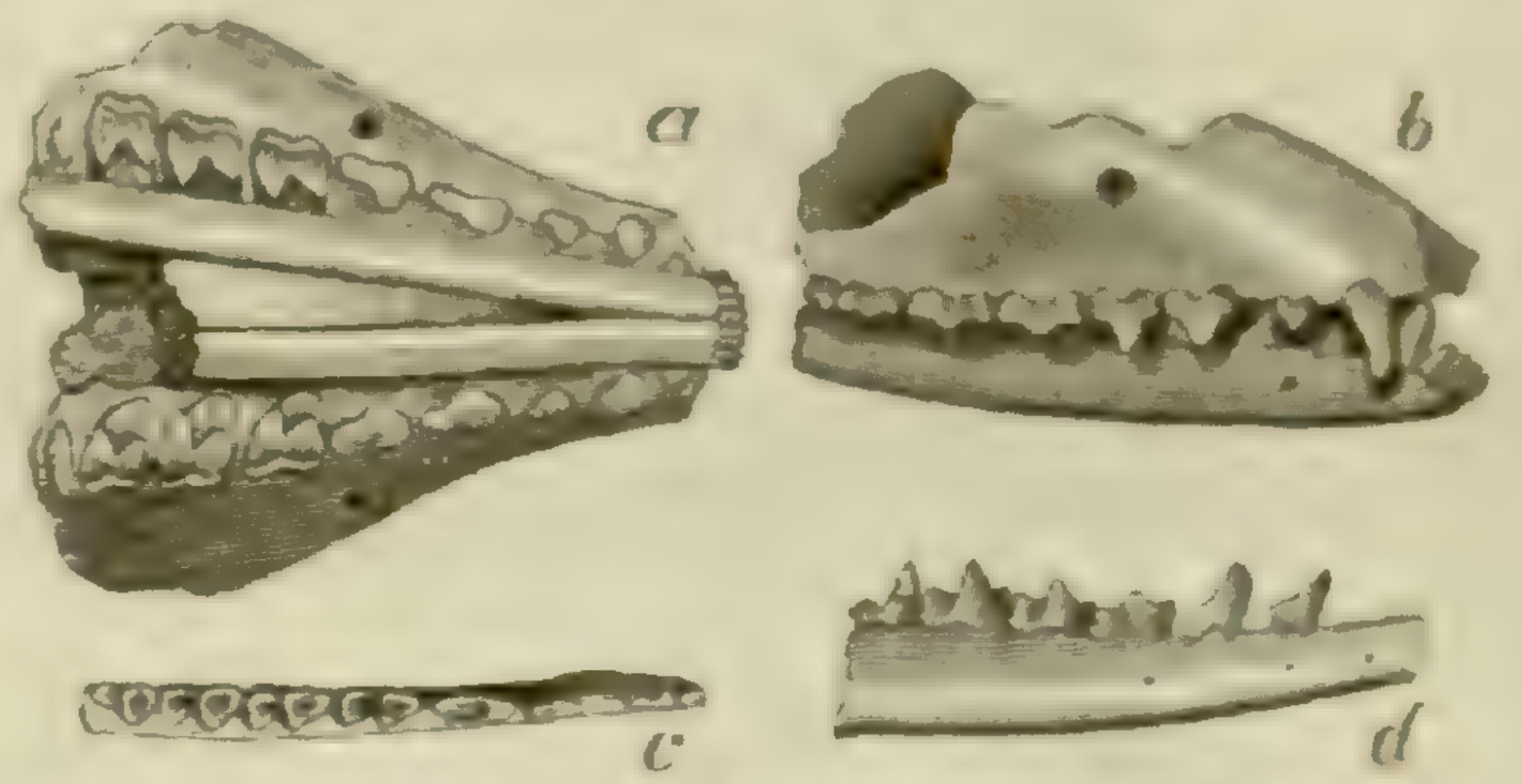

FIG. 1.—*Peratherium fugax* Cope, from the White River beds of Northeastern Colorado, twice natural size. Fig, *a*, anterior part of skull from below; *b*, do. right side; Fig. *c*, part of right mandibular ramus, with all the molars or their alveoli, from above; *d*, do., from the right side.

Of Poëphaga no extinct forms have been found in North America.

The Multituberculata include three families, which differ as follows:

Fourth superior premolar (at least) like true molars..... *Tritylodontidæ.*

Fourth premolars (and probably others) more simple than first true molars *Polymastodontidæ.*

Fourth premolars (and often others) developed into flat cutting blades *Plagiaulacidæ.*

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[1]Owen places the Phascolomyidæ in a distinct suborder, but, as it appears to me, without sufficient reason. [2]Bulletin U. S. Geol. Survey Terrs, V, No. 1, p. 45.

In all three of these families the incisor teeth are in reduced numbers, and are constructed on the rodent type, with an external band of enamel. They thus approach the genus Phascolomys (wombat), one of the Poëphaga of the existing Australian fauna. The genus Tritylodon (Fig. 2), recently described by Owen, is from the South African Trias. It is a remarkably specialized form, considering its geological antiquity. Its formula above is, I. 2; Pm. 4; M. 3. The lower jaw is unknown. The median incisors are developed at the expense of the laterals, and are separated by a wide interspace. There is also a maxillary diastema. The molars and last premolars all support three rows of shortly conic tubercles (Fig. 7 *h*). The genus Stereognathus

FIG. 2.—*Tritylodon longævus* Owen, anterior part of skull, natural size; from the Triassic beds of S. Africa. Fig. *a*, from below; *b*, from above. From Owen, Quart. Journ. Geol. Society, 1884, p. 146.

Charlesw., includes species from the English Oölite. The known molars have three longitudinal rows of crescentic tubercles (Fig. 7 *b*). The species are no larger than a small shrew, while the skull of *Tritylodon longævus* is as large as that of a gray fox. Information as to the structure of the skeleton of these remarkable forms has not yet been obtained.

There is but one genus of the Polymastodontidæ, the Polymastodon Cope. It is known from three species, all from the Puerco Eocene of New Mexico. The largest, *P. taoënsis* Cope, has bones equal in size to those of the large kangaroo, *Macropus major*. The jaw of the smallest species, *P. foliatus* (Fig. 5), is as large as that of *Hyrax capensis*; that of the third species, *P. fissidens*

Cope, is intermediate in dimensions, and the dentition has some well-marked peculiarities. The characters of the skeleton, so far as known, are derived from the *P. taoënsis* (Figs. 3 and 4).

The angle of the lower jaw is inflected, and the dental foramen is at the anterior apex of a large fossa, as in most marsupials. There are but two true molars in each jaw, and a single simple premolar, below. The condyle of the humerus presents characters shared by Meniscoëssus of the Laramie, which are found in lizards. There is a strong and thick intertrochlear ridge in front, which is so swollen at one side of the middle line as to resemble the condyle

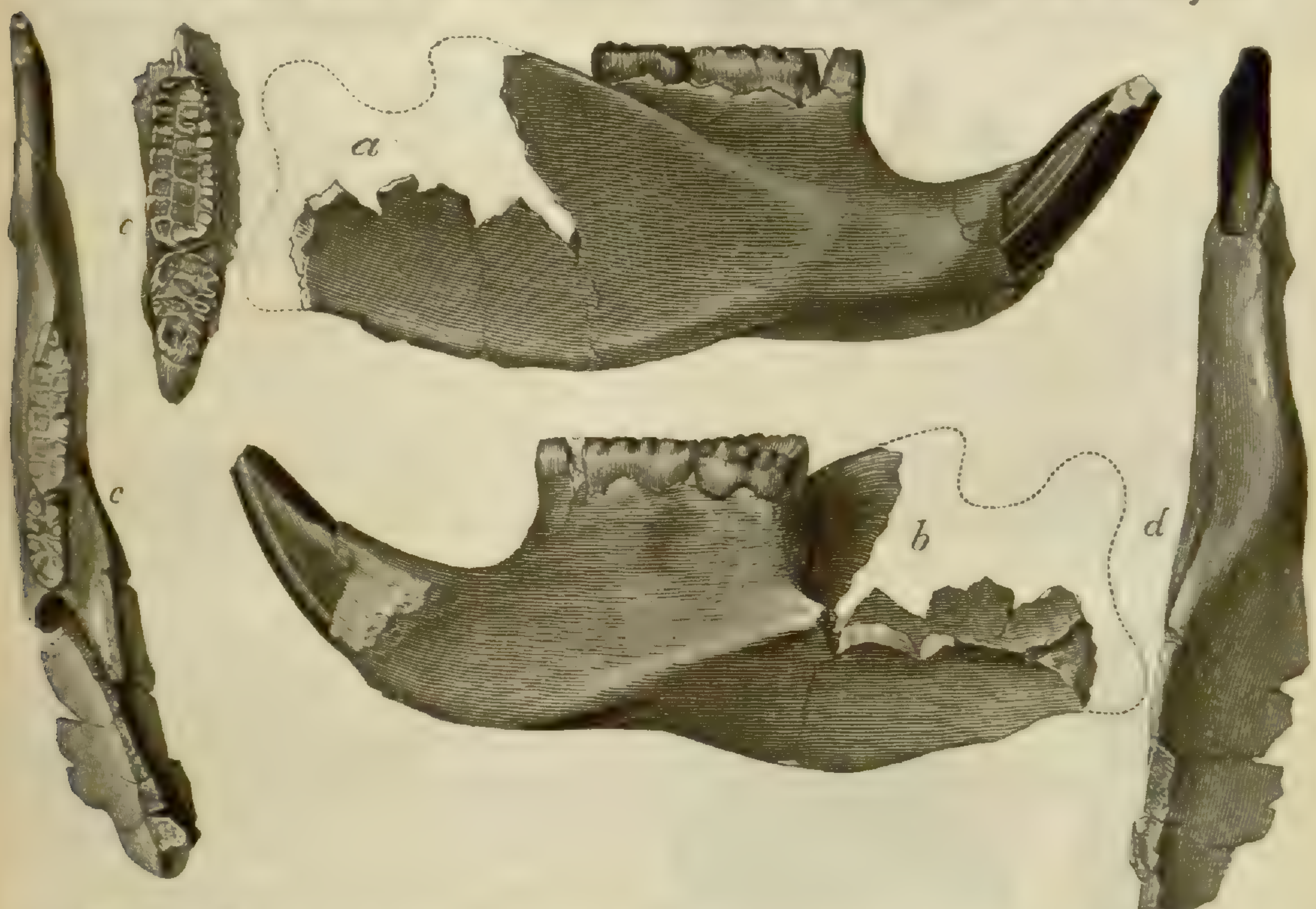


FIG. 3.—*Polymastodon taoënsis* Cope, jaws, two-thirds nat. size; from the Lower Puerco beds of New Mexico. Fig. *a*, right mandibular ramus right side; *b*, do., internal side; *c*, do., from above; *d*, from below. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden in charge, Vol. III.

of a femur. The trochlea for the coronoid process of the ulna, on the posterior side, is narrowed so as to suggest a rotular groove (Fig. 4*b'*). The humeral cotylus of the ulna is adapted to this condyle by a flare on each side (Fig. 4*c*). The astragalus is without trochlea, as in most Puerco Mammalia, and the trochlear portion is gently convex anteroposteriorly. The head is much narrowed, and has a narrow navicular face which is convex in only one, the vertical, direction. On its outer side it bears a large flat facet for the cuboid bone (Fig. 4*d'*). This form is much like that of the kangaroos. It shows that the peculiar structure of the posterior foot of the Macropodidæ already existed at this early day, though

perhaps in not quite so specialized a condition as at the present time. The form of the astragalus shows that the internal digits

FIG. 4.—*Polymastodon taoënsis* Cope; parts of individual represented in Fig. 3, two-thirds nat. size. Fig. 4*a*, caudal vertebra, front; *a'*, do., left side; *b*, humerus, distal portion, front; *b'*, posterior side. Fig. 4*c*, ulna, proximal part, front side; *c'*, from above. Fig. 4*d*, astragalus, from above; *d'*, do., from external side. Original, from Report U. S. G. Survey Terrs., F. V. Hayden in charge, Vol. III.

are of very reduced size, the first probably wanting, in Polymastodon, and that the external digits were large and constituted the principal agent in progression. That the animal had a large tail is proven by the few caudal vertebræ preserved (Fig. 4*aa'*).

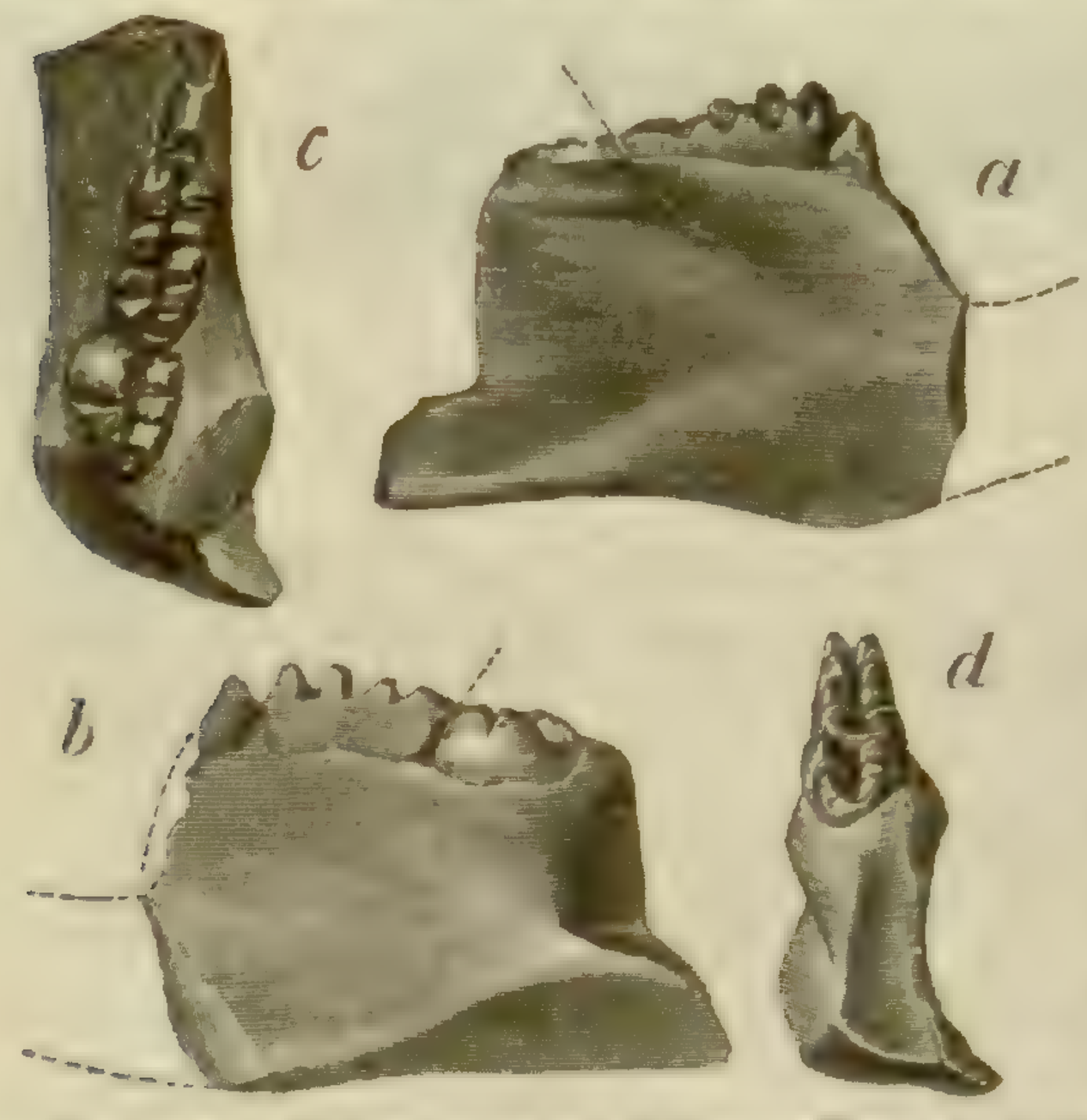


FIG. 5.—*Polymastodon foliatus* Cope; part of right mandibular ramus, natural size, Fig. 5*a*, right side; *b*, left do.; *c*, from above; *d*, posterior view, showing masseteric and dental fossæ. From the Lower Puerco of New Mexico. Original, from the Report of the U. S. Geol. Survey Terrs., F. V. Hayden, Vol. III.

The inferior molars have but two rows of tubercles, and the penultimate is much larger than the last one. The former tooth looks a good deal like a reduced last inferior molar of some species of Mastodon. The family was of herbivorous habits, and is probably the ancestral type of the kangaroos. The discovery of this remarkable genus in our Lower Eocene beds marks an important advance in the knowledge of the origin

of one of the most interesting of living forms. On the other hand, the Polymastodontidæ may well have derived their origin from the Tritylodontidæ, which were also of herbivorous or granivorous habits. The family of the Plagiaulacidæ[1] is one of the most peculiar among those of the Mammalia, whether we consider its structure or its relations to geological time. Commencing in the Jurassic period, it persisted through the Cretaceous to the Eocene. It then disappeared from view to remind us once more of its existence by its probable descendant, the extraordinary pouched lion of the Pliocene period of Australia, *Thylacoleo carnifex* Owen (Fig. 9). The family exhibits the usual successional relation of its component genera. In this respect it repeats what I have already pointed out as a law of succession in placental Mammalia,[2] a reduction in the number of premolar teeth. The following table exhibits these relations:

I. Tubercles of superior molar crescentic.

Fourth premolar serrate, not ridged.....*Meniscoëssus.*

II. Tubercles of molars subconic.

a. Four compressed premolars below.

Premolars serrate, not ridged.....*Ctenacodon.*

Premolars ridged and serrate.....*Plioprion.*[3]

aa. Three compressed premolars.

Premolars ridged.....*Plagiaulax.*

aaa. Two premolars.

Fourth premolar ridged.....*Ptilodus.*

aaaa. One premolar.[4]

Fourth premolar ridged.....*Neoplagiaulax.*

Fourth premolar smooth.....*Liotomus.*[5]

Of these seven genera but nine species are thus far known. Ptilodus and Ctenacodon have two species each; and each of the others but one. Ctenacodon, Plagiaulax and Plioprion are Jurassic; Meniscoëssus is Cretaceous, and the remaining three genera are Eocene Tertiary. The American genera are Ctenacodon Marsh (Fig. 7 *g*), Meniscoëssus Cope, and Ptilodus Cope. The first named is the most generalized of the family. The *Meniscoëssus conquistus* Cope, has the distinction of being the only known mammal of the Cretaceous period.

[1] This family is the equivalent of Marsh's "order" Allotheria.

[2] Bulletin U. S. Geol. Survey Terrs., VI, p. 168.

[3] Gen. nov., type *Plagiaulax minor* Falconer.

[4] Number unknown in Liotomus.

[5] Gen. nov., type *Neoplagiaulax marshii* Lemoine.

The genus first discovered was the Plagiaulax of Owen, of which the typical species was found in the Purbeck bed of the Isle of Wight, England. It was made the subject of a memoir by Falconer. Ctenacodon was next discovered in the Jurassic of Wyoming by Marsh in 1879. In 1880 Dr. Lemoine discovered the first Tertiary representative of the family, and in 1882 named it *Neoplagiaulax eocænus* (Fig. 6). In November, 1881, I described the first American Tertiary form, which was discovered in the Puerco beds of New Mexico, under the name of *Ptilodus*

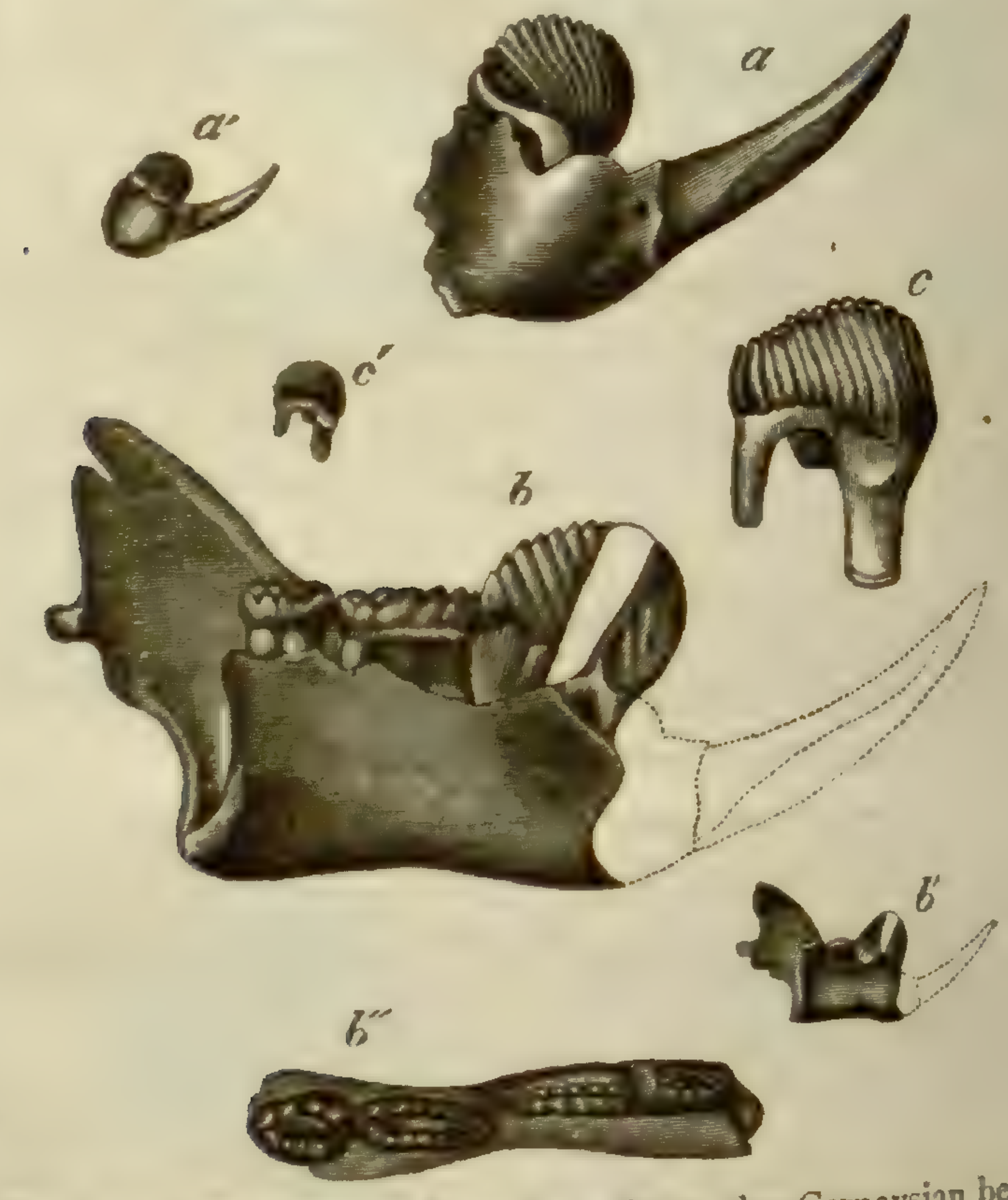


FIG. 6.—*Neoplagiaulax eocænus* Lemoine, from the Cernaysian beds of Reims, France; mandibular rami and teeth of three individuals which are represented by the letters *a*, *b* and *c*. Figs. *a*, *b*, and *c*, much enlarged. Figs. *a'*, *b'* and *c'*, natural size. Fig. *b'''*, from above. From Lemoine, Bulletin de Soc. Geol. de France, 1882, p. 249.

mediævus (Fig. 8). Its presence in that formation, together with various other associated types, proved the near homotaxy of the beds explored by Dr. Lemoine near Reims with those of New Mexico.[1]

Up to this time the great Cretaceous period had remained a blank in the history of Mammalian life. European palæontologists had examined the fresh-water beds of this period for mammalian remains without success. Among them, the gifted Kowalev-

[1] See the NATURALIST, 1883, p. 870.

sky, too soon lost to science, spent much time in the south of France among the formations which most nearly represent the American Laramie formation, but found no Mammalia. It remained for Mr. Wortman to crown a series of successful expeditions by the discovery of the *Meniscoëssus conquistus* in the Laramie formation of Dakota, its loose teeth being found mixed with the teeth of dinosaurs and scales of gar-fishes. The characters of the molar teeth are highly appropriate to the geological age of the genus, the superior molar resemblinhg bot that of the Jurassic Stereognathus and the Eocene Polymastodon.

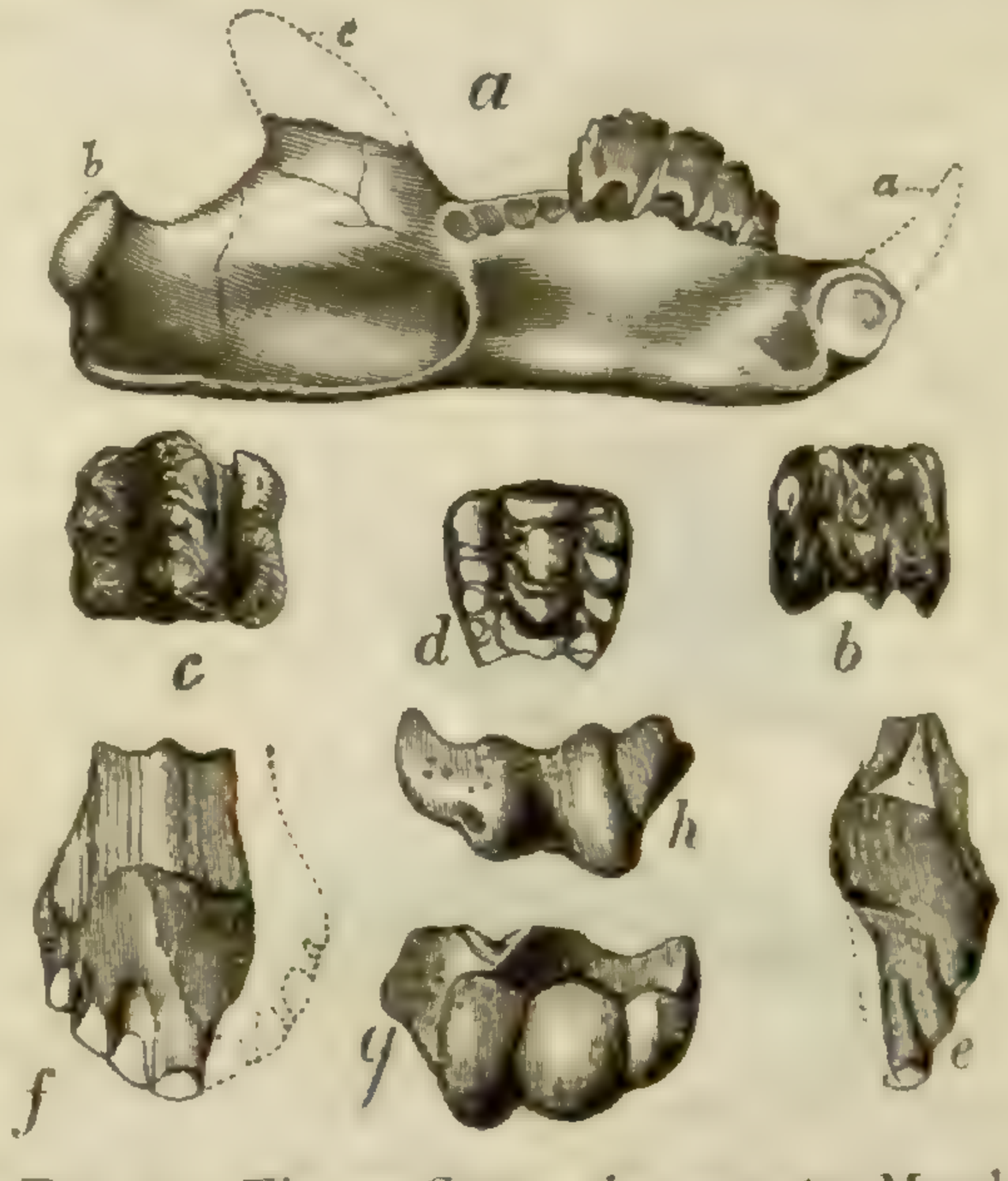


FIG. 7.—Fig. *a*, *Ctenacodon serratus* Marsh, $\frac{3}{1}$ nat. size, from Marsh. Fig. *b*, molar of *Stereognathus oöliticus*, $\frac{3}{1}$, from Owen. Fig *c*, right fourth upper molar of *Tritylodon longævus*, from Owen, $\frac{3}{1}$. Figs. *d–f*, *Meniscoëssus conquistus* Cope, $\frac{3}{2}$ nat. size. Fig. *d*, superior molar; Figs. *e–f*, superior fourth premolar[1]; *g*, humeral condyles of a smaller species with jaw, found with the *Meniscoëssus*.

I have shown that the cutting tooth of the lower jaw in the genera with but one such tooth, as Ptilodus and Thylacoleo, is the fourth premolar;[2] while the similar tooth in the existing kangaroo-rats, with which it has been compared, is a third premolar. In the living genera the fourth premolar resembles a true molar. It is necessary to remember this fact in the attempt to ascertain the phylogeny of the Multituberculata. This is not an entirely easy task, owing to the questions which arise as to the origin of the cutting premolars themselves. In general it is true of Mammalia that simple premolars precede the complex in time; but an exception to this rule is to be seen in the tritubercular superior sectorial tooth of some Creodonta and Carnivora. Whether the premolars of this family are primitive or derivative is not as yet known. If they be primitive they may be direct modifications of the serrate teeth of the herbivorous Dinosauria or Theromorpha. The complex character of the premolars in the older Tritylodon suggests the possibility of the other alternative. The general history of the Plagiaulacidæ con-

[1] This tooth may possibly belong to a Saurian.
[2] NATURALIST, 1882, p. 521.

firms the theory of derivation from complex premolars, and we observe in the later form, Thylacoleo, a simplification of the true molars also. The molariform fourth premolars in the existing Macropodidæ confirm this view. In order to connect these latter with the ancestral form of the Plagiaulacidæ, on a former occasion, I posited a theoretical form which should combine three of the cutting premolars of the extinct family with the molariform fourth premolar of the Macropodidæ. This I named Tritomodon.[1] The discovery of Tritylodon has added confirmation to this view, at least as regards the prior existence of the molariform premolars. The Polymastodontidæ were probably derived from the Tritylodontidæ by the usual process of reduction of number of teeth and specialization of those that remain. Thylacoleo[2] must be regarded as the type of a family distinct from the Plagiaulacidæ, since it has but one true molar tooth in the upper jaw. The composition of that tooth is unknown, so that it is not certain whether the family Thylacoleontidæ must be placed in the Multituberculata or Sarcophaga. That it is a direct descendant of the Plagiaulacidæ I think there is no doubt. The following phylogenetic scheme is similar to one I published in the NATURALIST, 1882, p. 521, with some addition, and the removal of Polymastodon (Catopsalis) from the Plagiaulacidæ:

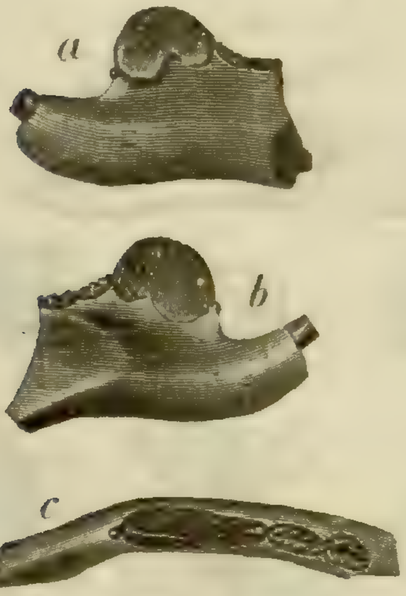
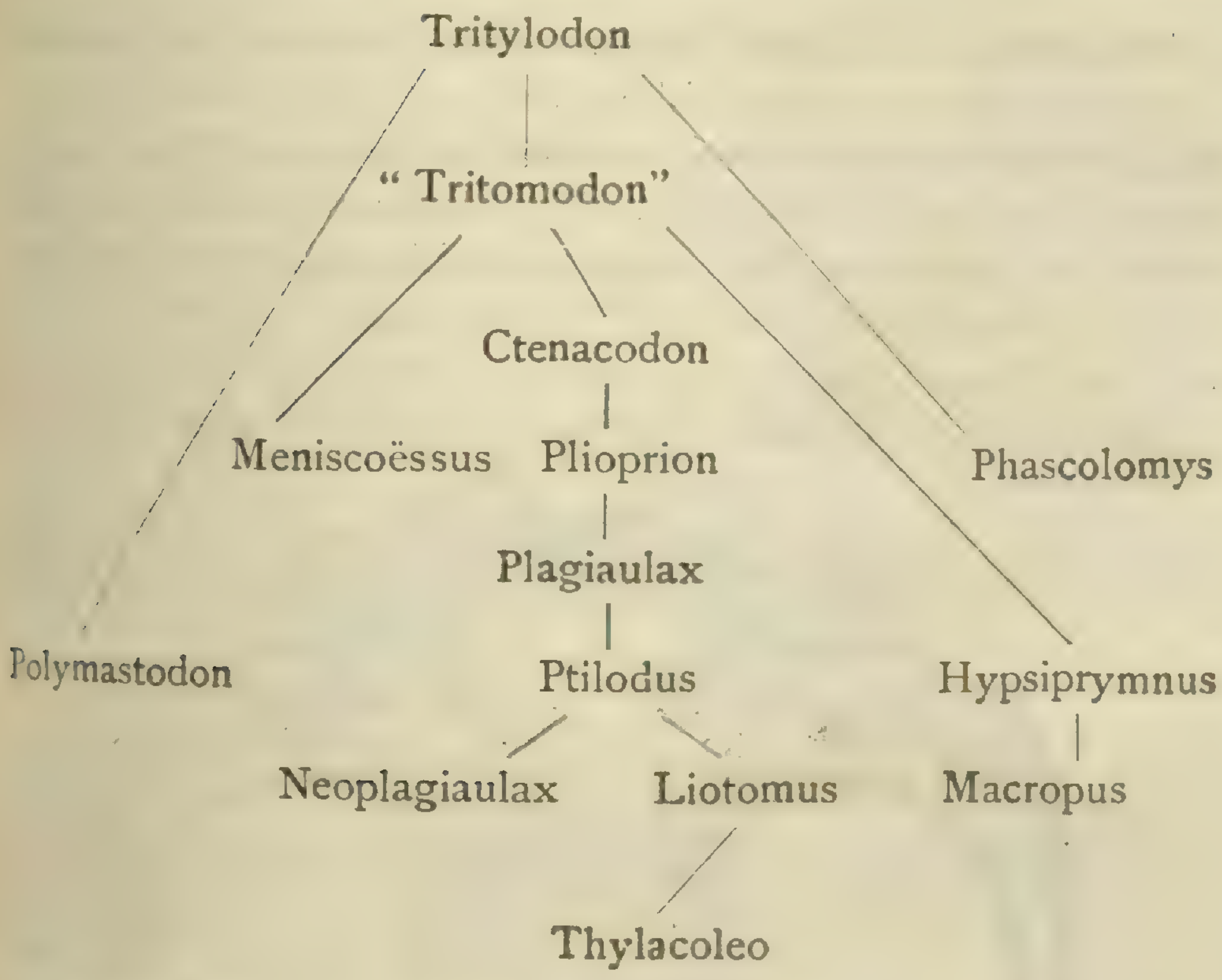


FIG. 8. — *Ptilodus mediævus* Cope, left mandibular ramus, nat. size; from the Upper Puerco beds of New Mexico. Fig. *a*, external side; *b*, internal do.; *c*, superior view, $\frac{3}{2}$ nat. size. Original, from Report U. S. Geol. Survey Terrs., III, F. V. Hayden in charge.

[1] NATURALIST, 1882, p. 521.

[2] Owen, Quar. Journ. Geol. Society, London, 1883.



It appears from the preceding considerations that the dentition of the implacental Mammalia has had a history independent of that of the placental series so far as regards the herbivorous types at least. I have shown that the primitive types of the placental series were tritubercular, and then quadritubercular, and then crested. In the herbivorous marsupials, on the contrary, we commence with multitubercular forms, and it is yet an open question whether these have had a quadri- and tritubercular ancestry or not.

The Plagiaulacidæ of the Jurassic period are of very small size, none of them exceeding in dimensions the house mouse. The same is true of the species of the Eocene period hitherto found in Europe. The American species are larger, the *Ptilodus mediævus* equaling probably the Norway rat (Fig. 8), while the *P. trovessartianus* is one-third smaller. The *Meniscoëssus conquistus* is still larger, equaling about the *Polymastodon foliatus* (Fig. 7). The arrangement of the crests of the fourth premolar in the species of Plagiaulacidæ differs as follows: In Plagiaulax, Plioprion and Neoplagiaulax this tooth is grooved. In Ptilodus the grooves have become so wide (Fig. 8) that the wide intervening ribs have become narrow keels. In Meniscoëssus there are no keels, but the margin of the crown is serrate (Fig. 7 *a c*).

The *Ptilodus mediævus* further differs from the *Neoplagiaulax eocænus* in the more rodent-like character of its incisor teeth. In the latter species these teeth resemble more those of the kangaroos in their anterior direction. The diastema is longer in Ptilodus, thus increasing the rodent resemblance. The fourth premolar is strongly serrate in the Neoplagiaulax, resembling in this also the Mesozoic types.

The discussion between Professor Owen on the one side, and

FIG. 9.—*Thylacoleo carnifex* Owen; skull from below, one-half nat. size: from the Pliocene beds of Australia. From restoration by Professor Owen in *Geological Magazine*, 1883, p. 289.

Messrs. Falconer, Krefft and Flower on the other, as to the nature of the food of Thylacoleo, is known to palæontologists. From the form of the teeth alone, Professor Owen inferred the carnivorous nature of the food of this genus, while his opponents inferred a herbivorous diet from the resemblance between the dentition and that of the herbivorous Hypsiprymnus. I have pointed out (*l. c.*) that the comparison of Thylacoleo with Hypsiprimnus

is weakened by two considerations: First, the cutting teeth in the two genera are not homologous; second, the grinding series of molars, complete in Hypsiprymnus, is almost wanting in Thylacoleo. It evidently does not follow that because Hypsiprymnus is herbivorous Thylacoleo is so also. Professor Flower refers to the reduction of the molars in Thylacoleo as slightly complicating the problem, and concludes that the food of that animal may have been fruit or juicy roots, or even meat. It is difficult to imagine what kind of vegetable food could have been appropriated by such a dentition as that of Ptilodus and Thylacoleo. The sharp, thin, serrate or smooth edges are adapted for making cuts and dividing food into pieces. That these pieces were swallowed whole is indicated by the small size and weak structure of the molar teeth, which are not adapted for crushing or grinding anything but very small and soft bodies, It is not necessary to suppose that the dentition was used on the same kind of food in the large and the small species. In *Ptilodus mediævus* the diet may have consisted of small eggs which were picked up by the incisors and cut by the fourth premolars. In *Thylacoleo carnifex* it might have been larger eggs, as those of the crocodiles, or even the weaker living animals. The objection to the supposition that the food consisted of vegetables, is found in the necessity of swallowing the pieces without mastication. In case it should have been of a vegetable character the peculiar premolar teeth would cut off pieces of fruits and other soft parts as suggested by Professor Flower, but that these genera could have been herbivorous in the manner of the existing kangaroos, with their full series of molars in both jaws, is clearly an inadmissible supposition.

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VESTIGES OF GLACIAL MAN IN MINNESOTA.

BY MISS FRANC E. BABBITT.

(Continued from page 605, June number.)

THE notch quartzes hitherto examined have been differentiated by marked peculiarities of distribution, worth while to enumerate in this place.

First: as there were originally no quartzes afforded by the soil above the stratum, so there were none yielded by that lying immediately below; although it would naturally be expected that

the floor of a primitive manufacturing site of this character would be permeated to a considerable depth with chips and other refuse. If in studying the quartz bed, for example, the hand, introduced within it horizontally, was carried at all above or below the superior or inferior plane of deposit, the fingers encountered no more fragments, except in spots where the layer had manifestly been thrown out of place by the growth of roots, and other recent agencies.

The uniform outline of the inferior plane of deposit, taken in connection with the total absence of chips and quartz fragments of every kind, from all explored portions of it, shows that these objects were spread out, primarily, upon a passably level surface of a compact, unyielding nature, such as might have been afforded by a firm sod, or by frozen ground. This peculiar feature of the situation, together with other facts hereafter to be stated, suggests the probability that the quartz deposit is somewhat in the nature of a *cache*, the nucleus of which was an ancient site of manufacture of stone implements. Appearances indicate that shortly after receiving position here, these quartzes were either solidly encased in ice or permanently sealed up in the modified drift at present superimposed upon them. Had it been otherwise, had the containing stratum, prior to its final inhumation, been long subjected to the climatic vicissitudes incident to the actual isothermal line of the region, results would no doubt have followed which, though differing possibly in degree, would certainly have been identical in kind with those now wrought out at the same point. Thus great thaws, soaking and softening rains, and, in short, local floods, however caused, could not have failed to affect exposed quartzes, to have effectually deranged and perhaps altogether broken up the original level of their bed, and to have let numbers of the involved objects down to varying depths in the underlying stone rubbish, while sweeping others away bodily to be distributed about the subjacent sands. It is desirable to emphasize the fact that the specified movements of soil are not merely a matter of speculation, but are the subject of direct observation. They are now in progress before our eyes from day to day, not only at the quartz bed, but likewise at every explored point in the vicinity, at which quartz products of disintegration find lodgment upon a sandy substratum. Let it be observed that the present is not a case of degradation going on upon a basis of

rock affording permanent support to fragments detached. Even were it such, however, the quartzes would still have been subject to eolic influences whence we might look to see the successive products of ages of weathering widely disseminated and occupying different levels in the neighboring sand.

Second: it was a further peculiarity of the quartz layer that it did not thin out toward the west, in the direction of the river, as it should have done had its area been still intact. Contrawise, the quartzes extended in full thickness quite up to the extreme edge of the terrace-plain, where the deposit terminated abruptly in an obscuring layer of surface soil derived from the drift above. Previous to the inception of grading operations upon the notch, by which this ancient cache seems to have been nearly and perhaps quite obliterated, it was no infrequent thing, after heavy rains, to find quartzes, plainly extruded from the others, lying along the bottom-land west of their original bed.

The terrace consists properly of three sections, one above the other, which must have had their beginnings at three different periods. First, we have the lowest and oldest, comprising the body of till and drift below the quartzes; second, the quartz-yielding stratum itself; and third, and newest, the accumulations of modified drift above the latter. This classification is based on existing geological conditions, and formulates the necessary sequence of glacial events. It is, therefore, by no means an abstract or an arbitrary division. It is moreover not affected by the question whether or not the quartz layer is artificial in character. Even were it a proven fact that these fragments are wholly natural forms resulting from the wearing down of quartz veins, it would still be true that the quartzes must, at the time of their deposit, have occupied a surface now no longer existing as such, within the present plane of the middle section. The truncated condition of the western edge of the quartz layer, coinciding with that of the terrace-bank above it, points us back to a time when the two uppermost of these sections had as yet no existence, while the lower one, projected west of its present limits, was prepared to receive upon its surface, as in time it actually did receive, the quartzes now above it. The middle section, that is the stratum of quartzes, must in its turn have had a like westward prolongation. The superior section, deposited later still, participated in the same general extension. When the Mis-

sissippi finally withdrew permanently from the terrace-plain, and cutting out a lower bed for itself in the drift alluvium, formed the existing terrace-bank, it would naturally leave the quartz stratum what we find it to-day. That is, the western border having been cut off and swept away, the western limits of the remainder would preserve a general thickness uniform with that of the central portion, or nearly so.

During a copious and long-continued rainfall in the summer of 1881, the roadway leading through the notch was at one time washed out at its point of emergence and westward to a depth of four or five feet below the quartz stratum. The lower portion of the newly exposed surface was then seen to be stuck full of quartz chips intermingled with occasional quartz implements. These seemed to be vestiges of a former westward prolongation of the quartz-bearing stratum. An irregular block of quartz, from eight to twelve inches in dimension, was here found impacted in the stone rubbish at the top of the till. This is remarkable as being the only lump of quartz larger than a club-head ever encountered among the thousands taken from the place. The block was white, sharply angular, and wholly unwaterworn; it was associated with subangular and rounded stones which had no other visible unwaterworn fragments among them; and it had, still adhering to certain of its planes, foliations of some other mineral of so soft a nature that the blocks would inevitably have yielded to attrition had it ever been subjected thereto. Every appearance indicated that this was a mass which had been used to strike pieces from for further manipulation. It was imbedded among the quartz bits and implements before mentioned. These were strewn about in the utmost confusion, being wedged into the stone rubbish at every imaginable angle. Many of the latter specimens, unlike those from the stratum, were more or less defaced, having small, long bits nicked out of the surface. Among them were some few objects which belonged to stratum types, but which were nevertheless waterworn.

Third: certain of the quartzes of the stratum have been distinctly arranged upon the floor of deposit in little rudely assorted heaps or groups of objects of some one particular type. As a representative fact or two will very likely afford a clearer view of the case than can otherwise be had, a few illustrative details are offered here. During the autumn of 1879, upon the day when

the existence of the quartz-bearing stratum was first definitely settled, I collected from it a half peck, or such a matter, of quartz pieces. Among these appeared a group of specimens numbering a dozen or more, which belonged to a type unknown to me at the time. The most finished implements of this shape have delicate, fragile edges formed by a single thin leaf of the quartz prolonged beyond the mass of the object in a series of irregular, minute notches. Further exploration of the site, continued up to the present time, has, so for as observed, failed to unearth a single specimen of the same class elsewhere. Whether we assume these small articles to be natural productions or artificial ones, or whether again we hold them to be natural forms more or less modified by the hand of man, there is no escaping the conviction that the grouping together of these and other like objects is wholly the work of intention. Previous to the discovery here narrated, I had more than once or twice chanced upon bunches of specimens of a common figure, lying in separate huddles in the sand at the edge of the stratum, and apparently just washed out of it.

Upon another occasion I found in my daily budget a small cluster of rude triangular points, quite unfashioned, as I thought, and averaging about an inch and a fourth, or a half, in length, by three-fourths of an inch in width. These being at first supposed to be unwrought figures, were thrown out as such. However, the persistent recurrence of identical forms in the day's yield eventually suggested a meaning of its own independent of the matter of workmanship. These bits were consequently put in comparison with fragments taken from waterworn quartz boulders from the edge of the Mississippi river, artificially broken up. It was found that certain of these boulders afforded by their fracture occasional specimens of the same general shape with those under study, while upon closer examination it was perceived that a considerable portion of the latter had at the base, upon opposite edges, two very small roundish notches, such as would be required for securing the object to a slender shaft, or handle, of wood or bone. None of the pieces seemed to have been flaked except at these notches, and if they had been otherwise worked at all, they had simply had their natural angles smoothed down by abrasion upon some stone.

Similar assortments of specimens having a common form have

been brought to light in different portions of the stratum. Indeed, whenever I unearthed any individual object of comparatively large size, I very often, though by no means invariably, found it to be associated closely with others of kindred type. I have exhumed from this place groups of axe-like quartzes, of rasping stones, of broken implements, of long prong-shaped objects perhaps utilized by primitive man as weapons, and of other rudely fashioned things at the particular uses of which it is impossible to guess. However, there were also divers quartz shapes which were scattered about through the whole deposit, such as hammer-stones of different descriptions, sharp pieces adaptable as cutting-blades and a great many sharp and long splinters. Some of the latter have been more or less wrought, while others of ruder model appear to have been selected from accumulations of fractured quartz with reference to unknown industries.

The assorted arrangement of the stratum quartzes and the perfect preservation of even the very frailest of them are cognate facts, entirely congruous with the group of statements heretofore advanced. They show that this deposit did not suffer derangement before its final inhumation, nor at the period when the latter was in progress. They point strongly to the probability that these rude objects represent a palæolithic workshop and cache, the floor of which was shielded from disturbance by an icy envelop, or by the gentleness of movement of the encroaching waters, or by both of these causes combined, as is most likely. Were it otherwise possible for the quartz bed to be a product of disintegrating forces, it would still be incomprehensible that a stratum presenting the specific features of this, could have been exposed to the tumultuous action of air and frost during the time requisite for working out the degradation assumed. It is equally unintelligible that it has ever been attacked by the powerful currents of an onward-moving flood. These quartzes seem rather to have been submerged by some such gentle creeping action of water as we should expect in the case of a lake-like expansion produced by the backing up of water from below.

Fourth: the stratum quartzes comprise many distinct varieties of the mineral, distributed among a mass of pieces which have apparently been derived from the quartz-bearing slates of the vicinity. These fragments show strongly marked differences in

opaqueness, color, hardness, cleavage and admixture of foreign matter. The mode of occurrence of the more erratic specimens is noteworthy, and leads to the inference that they may have been fashioned from drift boulders, numbers of them, indeed, having been evidently formed of waterworn pebbles. Objects shaped from some special variety of quartz not unfrequently present themselves in loose clusters, varying in number from two or three to a dozen or so pieces. Thus a single specimen of a tinted, mottled or otherwise distinguishable quality, has quite commonly been found associated with others of the same species of mineral. When one of these is of comparatively large size, the remaining objects are in many cases proportionally small, as if they had been shaped from fragments of the largest. In one part of the stratum I chanced upon several small quartzes which were, for the most part, longish splinters, and which had a peculiar sort of oölitic fracture closely resembling the grain of curly maple. I have never happened to find this sort of fracture in quartz from the Little Falls slates, though such may perhaps exist; but in studying a few boulders from the till, artificially broken up, I discovered a single waterworn mass, ten to twelve inches in diameter, having the same fracture. I afterward, at various times, encountered pieces of similar character at the stratum, three or four perhaps in a spot. These fragments have all, I believe, been inconsiderable in size. Now had even a small lump of this special sort of mineral been either disintegrated, or broken up upon the ground by human agency, a confused mass of bits of different sizes must naturally have resulted—which is not the fact. It is therefore not unlikely that the peculiarity of its cleavage unfitted this quality of quartz for being worked into large implements, but that in accidentally reducing small boulders of it, the quartz-workers selected from the splinters such bits as could in some way be turned to profit.

Professor Winchell says of terrace surfaces adjacent to the quartz stratum: "There is no point throughout the whole region round about where the slate conveying these quartz veins rises to the level of the surface of this plain so as to be within the range of transporting agencies, whether of the water of the river or of floating ice."

This statement concerning fragments diffused through the surface soil is, of course, not necessarily applicable to a plane a con-

siderable depth below that surface. In fact, slate rock has been encountered a little distance east of the notch at a depth of only fourteen feet. It is certain also that exposures of slate veins have long since been eaten away by the Mississippi river on the west, and it is highly probable that all these once afforded the quartz-workers abundant supplies for industrial purposes. A great proportion of the pieces found here have actually been furnished from the quartz-yielding rock of the place. This being the case, however, it is still certain that the imbedded quartzes could not have been drifted to their present position by currents of water, nor by ice. The facts above cited forbid the possibility of such transportation; and, as shown, it is equally incredible that long continued disintegration in the open air should have left upon the fragments successively resulting, no trace of weathering nor of belonging to different planes of deposit. On the whole, the prehistoric record of glacial man at Little Falls, as understood at the present stage of investigation, may be briefly summed up as follows.

The quartz-working people flourished at a day when the upper division of the terrace-plain had not yet been spread out. As we have seen, the basal section of the terrace consists of till coated with stone rubbish and covered with a thin layer of soil. It was precisely here, upon this old surface, that the quartz-workers lived and pursued their pitiful labors. In the fulness of time this vanished folk, perhaps foreseeing the calamity of flood, posed upon the earthen floor adjoining their working-place, the quartz implements of the stratum. The impending disaster finally ensued; the movement of the muddy water inhuming these objects was so gentle as not to break up the original arrangement of assorted groups, nor yet mar the most delicate edges and points of the imbedded pieces. The deposit of quartzes was, at last, hermetically sealed. Except at the western edge it has thus remained, quite in *statu quo*, up to the present time; although there has been a constant tendency on the part of natural agencies to erode the drift above, and expose once more to the light of the sun the rude remains of this primitive race.

The floods at length abated, the waters of the swollen Mississippi wholly subsided; the river abandoned the terrace-plain altogether, it dug out a new bed for itself at a lower level. During the latter process, or subsequent thereto, the current washed out

the western, or river, edge of the quartz deposit, and swept away all such products of man's labor as were at that time exposed to its action. The operating forces having been exerted upon the west of the present terrace-bank, it follows that only the eastern edge of the stratum remains to us, the western border being cut off and lost.

In finale, it is proper to reiterate the fact that the working hypothesis of the moment is one which the writer has been driven, in spite of preconceived notions, to adopt. All the internal evidence of the case, thus far elicited, harmonizes completely with the view enunciated, and with this view alone. The study here commenced is henceforth to be pursued along two distinct lines of investigation; one comprehending the drift surfaces of the region, the other the objects exhumed. The latter, or purely archæological phase of the subject, remains to be more fully developed at some future time; but it may be stated in this place that the quartzes of the cache are to the last degree primitive in their general types and particular forms, and in their style of workmanship.

A collection of something like a hundred of the quartz objects found in the notch at Little Falls has been submitted for examination to Professor Henry W. Haynes, of Boston, Mass., who writes of these specimens: "Some of them I believe to be implements; many are only chips struck off in shaping implements and refuse pieces left from such work; many are natural forms, and one or two rolled pebbles. I think that such objects as appear to be implements, in your collection, were managed by being held in the hand, and that early man had not advanced far enough to devise handles for his first rude implements. The masses of quartz were fitted for use by having most of their projections battered off by another stone; and if anything was required to soften the effect of the edges of stone upon the hand, it was a mass of moss, or leaves, or such object. I trace clearly upon your implements such a preparation of them for holding them in the hand. Many of yours bear evident marks of use in the worn condition of portions of their edges or of their points. When I look over the whole collection that I have made from different localities in New England of rude stone objects, mostly found at some depth below the surface, and compare their general appearance with that of my collection of Indian objects, I

see plainly a great difference. Applying the same test to your quartzes, I see that they belong, as a whole, to the older class. That you have discovered a workshop of early man there is no doubt." Again he says: "I will merely repeat that I have not a shadow of a doubt that the 'quartzes' you have submitted to me are the product of an intentional breaking by the hand of man, and not the result of natural causes."

At the annual meeting of the American Association for the Advancement of Science held at Minneapolis, Minn., August, 1883, a small number of objects from the stratum at the notch, and from its western line of extension along the terrace-bank, were placed for study in the hands of Professor F. W. Putnam, curator of the Peabody Museum of Archæology at Cambridge, Mass. It is with peculiar satisfaction I find myself able to record his decision that a certain part of the quartzes examined by him have indubitably been fashioned by the hand of man. At the same meeting of scientists the following résumé of the glacial situation at Little Falls was contributed to this paper by Mr. Warren Upham, of the State geological survey, to whose personal researches and official reports we are largely indebted for the drift history of Minnesota. The geological data of the present article have, in great part, been drawn from notes kindly supplied for the purpose by Mr. Upham. Mr. Upham says:

"Two principal epochs of glaciation are clearly recognizable, in the earlier of which the ice-sheet extended somewhat beyond the Missouri river and nearly to the Ohio river, crossing the latter at Cincinnati, as recently proved by Professor Wright. All of Minnesota was, at that time, deeply covered by ice, excepting a tract next to the Mississippi river from Lake Pepin southeastward, which is included in a driftless area that extends 150 miles from north to south, and is 100 miles wide, lying mostly in Wisconsin. In the succeeding interglacial epoch there is good evidence that the ice was melted away upon this region, and that a temperate climate existed. Afterward came the second and last great glacial epoch, when an ice-sheet again covered nearly all of Minnesota and accumulated the terminal moraines that have been described in Wisconsin, Minnesota, Iowa and Dakota. The ice in this epoch did not extend so far south as before. Its border in southeastern Minnesota was some fifty miles back from the edge of the driftless area. In Iowa the most southern point that was covered by the ice of this last epoch is in the vicinity of Des Moines, about 300 miles north of its earlier limit. The part of southwestern Minnesota lying beyond the crest of the Coteau

des Prairies escaped this later glaciation. The boundary of this ice-sheet, known by the course of its terminal moraine, entered Minnesota from Wisconsin across St. Croix lake; it crossed the Mississippi ten miles south of St. Paul, and thence extended about fifteen miles westerly to Crystal lake, in Dakota county, where the margin of the ice which moved southwestwardly from Lake Superior and northern Wisconsin met the margin of the ice which moved toward the south and southeast from the region of Lake Winnipeg and the Red River valley; from Crystal lake, the ice-border, at the east limit of the glacial current last mentioned, extended south through Rice, Steele, and Freeborn counties, into Iowa. Two currents of the ice-sheet, one coming from the northeast, the other from the northwest, were confluent, pushing against each other, upon an area reaching from Crystal lake and Lake Minnetonka 150 miles northwesterly to the Leaf hills, and even farther north to the lakes at the head of the Mississippi river. An area, or belt, extending thus, with a width varying from forty to a hundred miles, has a junction and overlapping of the till brought from the northwest and northeast, and series of morainic hills, which appear to prove that this region was wholly covered by the ice of the last glacial epoch; that the line of confluence of its currents was shifted in the latter part of this epoch far to the east upon a large district southeast of Stearns county, bringing till from the west over that from the east; and that during the final melting and disappearance of the ice, probably at times when this was interrupted by its reädvance upon part of the ground from which it had retreated, true terminal moraines were formed upon the sides of this belt which had been wholly ice-covered through most of this epoch. The inner moraine found in southern Minnesota and upon the Coteau des Prairies, the Leaf hills, and the very distinct series of morainic hills in Morrison county—one of which, accumulated by the ice-current from the northeast, lies close east of Little Falls—are of this kind, being terminal moraines formed at stages in the recession of the ice at the last glacial epoch.

"As soon as the ice had so far retreated as to uncover the present valley of the Mississippi river in Morrison county, the deposition of the modified drift, constituting the terrace-plain in which are found the quartz chippings, ensued, and continued during the retreat of the ice.[1] It seems very probable, that vegetation and animals followed close upon the retiring ice-border, and that even man, who lived near the Atlantic coast in this closing stage of the glacial period, as abundantly proved by recent discoveries in the drift-gravel near Trenton, N. J., may also have lived here at that time, and occupied the Mississippi valley directly after the

[1] It is to be borne in mind as an important fact that the Little Falls quartz stratum lies *at the bottom* of the old flood-plain. Hence the quartz-workers must have occupied this spot at the point of time when its deposition began.

ice-sheet retired. While the deposition of the valley-drift at Little Falls was still going forward, men may have lived there, and left, as the remnants of their manufacture of stone implements, the multitude of quartz fragments here described. By the continued deposition of the modified drift, lifting the river upon the surface of its glacial flood-plain, these quartz chips were deeply buried in that formation. The date of this valley-drift must be that of the retreat of the ice of the last glacial epoch, from whose melting were supplied both this sediment and the floods by which it was brought. The glacial flood-plain beneath whose surface the quartz fragments occur, was deposited in the same manner as additions are now made to the surface of the bottom-land; but the flooded condition of the river, by which this is done, was doubtless maintained through all the warm portion of the year, while the ice-sheet was being melted away upon the region of its head waters. In spring, autumn, and winter, or, in exceptional years, through much of the summer, it seems probable that the river was confined to a channel, being of insufficient volume to cover its flood-plain. At such a time this plain seems to have been the site of human habitations and industry, as shown in this paper.[1] After the complete disappearance of the ice from the basin of the Upper Mississippi, the supply of both water and sediment was so diminished that the river, from that time till now, has been occupied more in erosion than in deposition, and has cut its channel far below the level at which it then flowed, excavating and carrying to the Gulf of Mexico a great part of its glacial flood-plain, the remnants of which are seen as high terraces or plains upon each side of the river."

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The preservation of some herds of our larger game in the parks which are under the direction of the National Government is an object which has received the approval of various prominent persons from time to time. We believe that the constitution of the Yellowstone Park Commission contemplates the preservation of the game within its borders, but does not provide for the maintenance of herds of any size, or for any means of keeping them within the limits of the protected territory. It is asserted, however, that in point of fact the game is not better protected in the Yellowstone park than elsewhere.

[1] Evidence is at present wanting that the quartz-workers revisited this field of operations between the abandonment of the quartz stratum and the spreading out of the uppermost portion of the terrace-plain.

It is well known that the larger game of the far West has been long diminishing in numbers. This is especially true of the bison, an animal which is unable to escape from its pursuers, and which can hardly be called a game animal. The once huge Southern herd has been reduced to a few individuals in Northwestern Texas. The Dakota herd numbers only some 75,000 head, a number which will soon be reduced to zero if the present rate of extermination continues. The Montana herd is now the object of relentless slaughter, and will soon follow the course of the other two herds. When scattered individuals represent these herds, a few hunters will one day pick them off, and the species will be extinct.

Let the Government place a small herd in each of the national parks, and let the number be maintained at a definite figure. Let the excess escape into the surrounding country, so as to preserve the species for the hunters. Let herds of moose, elk, big-horn, black and white-tailed deer, and antelope, be maintained in the same way. Let the Carnivora roam at will; and in a word protect nature from the destructive outlawry of men whose prehistoric instincts are not yet dead. Let the newer instinct of admiration for nature's wonders have scope. Let the desire for knowledge of nature's greatest mystery, life, have some opportunity. Let there be kept a source of supply for zoölogical societies and museums, so that science may ever have material for its investigations. By securing the preservation of these noblest of nature's works, Congress will be but extending the work it has so grandly sustained in the past, in the support of scientific research and the education of the people.

To carry this plan into effect it will be necessary to have an efficient corps of foresters and gamekeepers. Any poaching on the parks must be punished with exemplary severity by the United States courts.

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RECENT LITERATURE.

THE ZOÖLOGICAL RECORD FOR 1882[1].—This volume is sixteen pages longer than its predecessor. The number of new genera and subgenera published in 1882 and recorded in the present volume is 1015, as against 1438 of Vol. XVIII. The editor adds that without the Protozoa, which in the latter comprised 483 from a

[1] *The Zoölogical Record for 1882;* being volume nineteenth of the Record of Zoölogical Literature. Edited by E. C. RYE. London, John Van Voorst, 1883.

single describer (Professor Haeckel), the number is greater by 70 in the present one. "These 1015 are divided as follows: Mammalia, 29; Aves, 19; Reptilia and Batrachia, 34; Pisces, 23; Mollusca and Molluscoida, 67; Crustacea, 46; Arachnida, 64; Myriopoda, 5; Insecta, 598; Vermes, 32; Echinodermata, 30; Cœlenterata, 27; Spongiida, 17; and Protozoa, 24. The unavoidable delay referred to in the preface has necessitated the publication of this long list of new names with scarcely any examination as regards prior occupation."

A number of changes have taken place in the staff of assistant editors, but we do not see that the quality of the reports has been lessened in value.

As regards Mammalia, the year 1882 did not differ materially from its predecessor in the large number of papers, anatomical, systematic and faunal, which appeared, though but few separate works of importance were published.

Of the ornithological publications of the year, special attention is called by the assistant editor, Mr. Sharpe, to the completion of Elliott's "Monograph of the Hornbills," Sclater's "Jacamars and Puff-birds," Salvadori's "Uccelli di Papuasia," and the atlas to the part "Aves" of the great work on the natural history of Madagascar, by MM. Milne-Edwards and Grandidier. Attention is also called to the valuable essays by Drs. Gadow and Krukenberg on the coloring of feathers. As usual the reports on insects fill nearly half the volume, *i. e.*, 292 pages.

As regards the value of this work to working naturalists, in this country especially, where few have access to large libraries, we can only repeat the statements heretofore made as to the usefulness of such a record as this. The report is subsidized, and, as a matter of course, endorsed by the British Association for the advancement of Science, as well as the Royal Society of London.

COLLINS'S MINERALOGY[1].—The system of classification adopted by the author is identical with that of Dana so far as the primary classes are concerned. The book is reprinted from the English edition, and like the first volume, published in 1878, was prepared for the use of "practical working miners, quarrymen and field geologists," as well as "students of the science classes in connection with the Department of Science and Art." The work, as the author says, is little more than a dictionary of minerals, which includes notices of all described up to the beginning of 1881.

The criticism we would make on this little unpretentious book, is that the class for which it is intended need full descriptions of the more common minerals and ores, their mode of occurrence and relations to one another, rather than a simple list with too brief descriptions of or reference to all that are known.

[1] *Putnam's Advanced Science Series. Mineralogy.* By J. H. COLLINS. Vol. II. [1884.] Systematic and descriptive Mineralogy, with upwards of 400 illustrations. 12mo., pp. 328.

We still need a brief class-book of mineralogy for college students and beginners, one which shall lead the student to carefully examine at least the physical characters of not over, say a hundred, of our rock-making and other more important minerals, such as are constantly met with by amateurs, miners and prospectors. Such a book should also enter fully into the methods of study for the examination of minerals by their physical characters, comprising a set of object-lessons which may be made of much value and interest to college and other classes.

THIRD REPORT OF THE U. S. ENTOMOLOGICAL COMMISSION.—This report forms a volume of 550 pages, with an appendix of nearly 100 pages, and is illustrated by sixty-four plates. It is divided into three parts. Part I, in reference to the Rocky Mountain locust, has five chapters. Chapter 1 comprises additions to the chronology of locust ravages in 1880 and 1881. Chapters 2, 3 and 4, by Mr. Lawrence Bruner, contain his reports and notes on the locust and cricket (Anabrus), giving the results of the expeditions made by him under direction of the Commission, into Northern Montana and British America, Chapter 5 is an essay on "the data obtained from solar physics and earthquake commotions applied to elucidate locust multiplication and migration," by A. H. Swinton, of England, communicated by him and published by the Commission without its endorsing all the author's views.

Part II comprises chapters 6–8, the 6th on the army worm; the 7th on the canker worm, each by C. V. Riley, and the 8th on the Hessian fly, by A. S. Packard, Jr., being a reprint, with additions and other changes, of Bulletin 4 of the Commission. Part III, Scientific results, comprise four chapters, each by A. S. Packard, Jr.; the 9th containing descriptions of certain larvæ of injurious forest insects, illustrated with numerous drawings by Dr. C. F. Gissler, and filling ten plates. Chapter 10 discusses in a fragmentary way certain points in the embryology of the *Caloptenus spretus* and *C. atlanis;* it contains some speculations as to the origin of the wings, and the genealogy of the insects. It closes with a brief account of some points in the development of the bark-boring beetle *Hylurgops pinifex* and *Xyleborus coelatus*, with remarks on the number of segments in the head of winged insects.

Chapter 11 is devoted to an essay on the systematic position of the Orthoptera in relation to other orders of insects, portions of which have appeared in the NATURALIST. This chapter is illustrated with forty-two plates, giving in a comparative way the leading points in the external anatomy of the Orthoptera, Dermatoptera, Pseudoneuroptera and Neuroptera.

Chapter 12 is a note of two pages explaining a zoō-geographical map of North America, with remarks on the distribution of locusts.

THE COAL AND IRON COUNTIES OF NORTH CAROLINA.—The mineral resources of North Carolina have been exposed by the recent survey of that State by Professor Kerr, and the present hand-book, which follows the foregoing, has been compiled by P. M. Hale, mainly from the reports of Emmons and of Kerr, for the purpose of calling the attention of the people of the State, as well as immigrants, to the mineral wealth of this naturally rich State. After describing the coal fields and iron ore beds in general, the coal and iron counties are separately described, the statistics being derived from the census reports of 1880. It is accompanied by a colored map of the State.

ZITTEL'S HAND-BOOK OF PALEONTOLOGY.—The third part of the second volume of this important work is devoted to the Cordaiteæ, but more especially to the Coniferæ; and the mode of treatment as well as the excellent illustrations will make it of great value to the investigator and student as well as the teacher. Here we have represented forms of the Gingko and allied genera of broad-leaved conifers which will be quite new to most of our readers; the same may be said of the fossil Araucariæ, as well as the Taxodineæ, nearly every genus of which is illustrated; so also of the Cypressineæ.

BREHM'S THIERLEBEN.—We have received the chromo-plates of ten mammalian subjects (Mappe 5)—and very beautiful and soft they are—of this magnificent work. It will be remembered that an edition of this work with a set of 170 chromo-lithographs is in course of publication. Those who possess the original work can obtain the colored plates separate of B. Westerman & Co., New York City.

RECENT BOOKS AND PAMPHLETS.

Lydekker, R.—Memoirs of the Geological Survey of India. Palæontologia Indica. Ser. X, Vol. II. Part IV. Siwalik Camelopardalidæ. Part VI. Siwalik and Narbada Carnivora. Calcutta, 1884. From the author.

Russell, I. C.—Sketch of the geological history of Lake Lahontan, a Quaternary lake of Northwestern Nevada. Washington, 1883. From the author.

Meek, Seth E., and Newland, R. G.—A review of the American species of the genus Sphyræna. Ext. Proceedings Nat. Sci. Phil., 1884. From the authors.

——Notes on a collection of Anchovies from Havana and Key West, with an account of a new species (*Stolephorus eurystole*) from Wood's Holl, Mass. Ext. idem., 1884. From the authors.

Jordan, D. S.—Notes on species of fishes improperly ascribed to the fauna of North America. Ext. Proceedings Nat. Sci. Phil., 1884. From the author.

——List of fishes from Egmont Key, Fla., in the museum of Yale College, with description of two new species. Ext. idem., 1884. From the author.

Owen, R.—On the skull and dentition of a Triassic mammal (*Tritylodon longævus*) from South Africa. Ext. Quart. Jour. Geol. Soc., Feb., 1884. From the author.

Socy. of Naturalists, E. U. S.—Records of the Society of Naturalists, E. U. S., Vol. I, Part I, 1884. From the society.

Geol. Society.—List of the Geological Society of London, Nov. 1, 1883. From the society.

Chapman H. C.—History of the discovery of the circulation of the blood. Phila., 1884. From the author.

Sims, Wm.—Kansas; its resources and capabilities, its position, dimensions and topography. Prepared by the State Board of Agriculture. Topeka, Kansas, 1883. From the author.

Brendel, Fredk.—Flora Peoriana. Die Vegetation im Clima von Mittel-Illinois. Ext. Termeszetrajzi Fuzelek, Vol. v, 1882. Budapest. From the author.

Mercer, S. W.—A new photo-micrographic camera. In "Photography," Chicago, May 1, 1884. From the author.

Greene, C. A.—An essay on insects injurious to vegetation.

Ryder, J. A.—A contribution to the embryology of osseous fishes, with special reference to the development of the cod (*Gadus morhua*). Washington, 1884. From the author.

Zoöl. Soc. London.—Report of the council of the Zoölogical Society of London for 1883. London, 1884. From the society.

Penna. State College.—Circular of the Pennsylvania State College of Agriculture, 1883.

——Agricultural Bulletins. No. v. Experiment on timothy and clover. No. vi. Feeding experiments. No. vii. An experiment with native potatoes.

Hawkins, Boyd.—The Channel tunnel. 1882. From the author.

Stefanescu, Gr.—Anuarulu Biuroului Geologicu. Anulu 1882–1883. Bucuresci, 1883. From the author.

Dabney, Ch. W.—Agricultural experiment station, N. C. Analyses and valuations of fertilizers. Made up to May 1st, 1884. From the author.

——North Carolina Phosphates. 1884. From the author.

Stevenson, W. G.—The physiological significance of vital force. From the author.

Frazer, Persifor.—Reply to a paper entitled "Notes on the Geology of Chester valley and vicinity." Ext. Jour. Franklin Inst., April, 1884. From the author.

Brinton D. G.—Aboriginal American authors. Phila., 1883. From the author.

White, J. W.—The prevention of syphilis. Rep. Phila. Medical Times, Jan. 14, 1882. From the author.

Rollins, J. S.—The forty-second Missouri University catalogue, 1883–1884.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—Letters from Lupton Bey, dated down to November 10th, give much geographical information, and a map of the region traveled over by Mr. Lupton or his agents, as far as the Khuta, a large stream which is thought to be a tributary of the Congo.

M. Mizon has written to the Geographical Society of Paris an account of his travels in the region of the Ogowe, its tributary the Liboumbi; the Luété, a tributary of the Niari; the lakes of Mayumba, and the basin of the Kuilu.

Ogadine is the name of a central district occupied by Somali tribes. On the west it borders on the Galla tribe of the Eunyas. The general aspect of the country is that of a steppe covered with long grass, but with stony gaps. The shepherd inhabitants are fanatical Mussulmans, always at war among themselves or

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

with their neighbors. Toward the Webbe the people are more agricultural. Each encampment has its iman, and every tribe its extempore poets.

Don Juan de Sosten (Bol. de la Soc. Geog. de Madrid) gives an account of his expedition in Eastern Africa. From Adowa (Tigre) he ascended the mountain Deyam, reputed the highest of the mountain range of that part, and found it to be 4631 meters in height. It was evident, however, that another peak, that of Bajuit, was higher; this was also ascended by Sr. Sosten, who found it to be 4917 meters in height, and capped with snow. Sr. Sosten afterwards explored the labyrinth of forest-covered mountains known as the district of Zebul (12° 12′ to 12° 47′ N. lat., 40° 25′ E. lon.). This is united on the south by a range of hills to the Ethiopian table-lands, from which it is distinct in its geology and its flora. Our traveler then crossed the Galla country to the west of Zebul, and proceeded southward, crossing several streams which pour from the eastern slope of the Ethiopian chain. Two of these, the names of which are written by him Mersé and Addifuha (Adifuya?), are not to be found in any map, nor have they been explored. Lake Haic (11° 23′ N. lat., 40° 5′ E. lon.) is 1920 meters above the Red sea, is surrounded by mountains from 2000 to 2500 meters in height, and covers some sixteen square miles. The principal stream flowing into this lake comes from the south and was tracked by our traveler to a previously unknown lake called Ardibbo, 2088 meters above the sea. This lake is somewhat smaller than Lake Haic. The water discharged by Lake Ardibbo into Lake Haic is twenty-nine times greater than that which it receives from streams, and it is an unexplained problem whence the water comes. From Lake Ardibbo our traveler proceeded eastward till he reached the Melle near the junction of the Addifuha. The Melle was then followed to its confluence with the Hauasch, which was seen to slope towards a large lake, probably Lake Ausa. At this point the bold traveler's intention to explore a route to the Red sea was frustrated by the appearance upon the hills of armed bodies of Gallas, of a tribe known to mutilate alive prisoners taken in war. To escape these, the Hauasch was crossed by night, a forced journey made to the south, and then a rapid retreat westward. Farther explorations were now stopped by a command from King John to appear before him to answer the accusations of an enemy, who asserted that Sr. Sosten was a spy of the Egyptian government. On the return journey the tombs of Cristobal de Gama and his companions, who in the fifteenth century fell in the service of the King of Abyssinia, were discovered.

The Pacific Islands.—*Krakatau.*—The late eruption has dismembered the Island of Krakatau. Part of it forms Steers island, eight miles to the north, while another part constitutes Calmeyer island, seven miles north-east, blocking the

east passage of the Straits of Sunda. Only the southern part of Krakatau remains, and there is nearly 170 fathoms of water where the remainder once stood. Lang island remains almost unaltered, but Verlaten island is largely increased. These two islands are believed by Mr. Norman Lockyer to be raised portions of the edge of a vast subsided crater, while the vanished part of Krakatau consisted of cones erupted upon the old crater floor, which has thus been cleared by the explosion. Vertical vibrations were noted at Batavia on May 20th, and ashes fell at Telok-betong and Semangka, in Sumatra. The movements seemed to come from the west, but Krakatau was quiet, and nothing was noted at Anjer, twenty-seven miles from Krakatau. On the evening of the 21st smoke was observed to issue from that peak, which thenceforward continued active, but as no great disturbance occurred, its eruption was scarcely noted at Batavia, eighty miles distant. In a letter to *Nature*, Mr. H. O. Forbes records the passage, on July 11th and 12th, of the vessel he was in through extensive fields of pumice, the nodules of which were worn, and in some cases bore barnacles of four or five weeks growth. On August 1st the steamer *Siam* sailed for four hours through a pumice sheet 700 miles from Sumatra, at a spot where there was 2000 fathoms of water. The current was running eastward, while the locality was some sixteen degrees west of Krakatau. As it seems impossible that this pumice came from that volcano, it is supposed that its final explosion was probably preceded by a submarine outburst in the Indian ocean.

On August 21st Krakatau increased in activity, and on the 26th violent explosions took place, accompanied by high waves which caused much damage. A night of pitchy darkness, and terrifying electric phenomena followed this. Between five and seven o'clock on the morning of the 27th came the first grand explosion. The column of smoke and ashes could be seen from Batavia, and the whole western end of Java and the south of Sumatra for hundreds of square miles was covered with the débris.

Between ten and twelve in the forenoon of the same day the last supreme outburst occurred, and spread consternation across a diameter of 3000 miles. The great tidal waves were registered by the tide-gauges four times round the globe; and from that day to the present time unusual phenomena have taken place that are probably referable to this grand explosion.

Mr. Chalmers has recently returned from a voyage along the coast of New Guinea. He has discovered a new river, which he has named the Wykeham, and believes that this and a number of other river mouths near it form the delta of a great river which probably drains the north side of the great mountain range of New Guinea. It is thought at Port Moresby that probably

D'Albertis in his voyage up the Fly river missed the main body of water.

J. Peltzer writes from Tucson, Arizona, to the Société Royal Belge de Géographie, to prove that the Polynesians are not a Malay, but a pre-Malay race. This race he believes to be identical with the Dyaks of Borneo, and to have spread from that island over Sumatra, Java, and other East Indian islands, previous to the arrival of the Malays. Everywhere where they colonized they displaced the Papuan races, but when the Malays came as a conquering race from the coasts of Hindostan, towards the first century of our era, this people of Dyak origin was partly pressed in to the interior of the large islands, but partly emigrated eastward in their prahus, colonizing the islands of Oceanica. The Malays, once Brahminists, are now Mussulmans, and everywhere repudiate any relationship with the peoples of the interior, the "Orangs Benua" or "men of the land" of Sumatra, the "Orangs Gœnong" or "men of the mountains" of Java, or the Dyaks of Borneo.

M. Peltzer asserts that the Polynesian languages do not contain more than thirty words of Malay origin, a number which may easily be accounted for by the relations between the Dyaks and the Malays who conquered the coast of Borneo. There are great resemblances between the traditions and religious customs of the Dyaks and of the Polynesians. The Tabu of the latter is identical with the Pamali of the former. Among both peoples woman has an inferior position, yet may become chief or queen of a tribe. Both peoples build large dwellings used in common. The Tahitians and people of the Marquesas expose their dead on platforms, and the Dyaks expose the bodies of their chiefs in a similar way.

Geographical Notes.——Major Holdich has succeeded in ascending Takht-i-Suliman, overlooking the Indus valley, and has triangulated over 50,000 square miles from its summit.——The furthest point inland reached by Lieut. Armil, though 120 miles from Port Moresby, was probably not more than forty from the southern coast. The natives were found to be very friendly. The country was mountainous and difficult, but exceedingly fertile and beautiful.——Mr. H. Drummond reports that the soil south of Lake Shirwa is thin and poor, and the district quite uninhabited. It is evidently the dried-up bed of a much larger Shirwa. The height of the lake was found to be lower by nearly 200 feet than it is given on Ravenstein's map, where it is marked 2000 feet. The natives say that the Lujenda does not flow out of Lake Shirwa, but is separated from it by a large sandbank.——Capt. Sörensen reports land north-east of Spitzbergen, about 110 English miles from Rep island. This is probably the same as that seen by Capt. Kjeldsen in 1876, and named White island.

GEOLOGY AND PALÆONTOLOGY.

LYDEKKER ON EXTINCT MAMMALIA OF INDIA.[1]—The noble volume below named, concludes the first part of the work of Dr. Lydekker on the Fossil Mammalia of India. It covers a part of the subject which was left very incomplete by Cautley and Falconer, and includes much new matter. It adds materially to our knowledge of the Mustelidæ, Ursidæ, Canidæ, Viverridæ, Felidæ, and Hyænidæ. Dr. Lydekker shows that India, in the late Miocene period, was the headquarters of the genus Hyæna, there being no less than five species represented in the collection. Of Ursidæ there are five species, viz., two of Ursus and three of Hyænarctus, of which one Ursus and two Hyænarcti are new. The latter genus receives thorough treatment, and Dr. Lydekker has added greatly to our knowledge of its characters. There are four species of Canidæ and nine of Felidæ. Of the latter, two species are sabre tooths. Two species of Mellivora and one of Mellivorodon (gen. nov.) represent the Mustelidæ.

The descriptions of the species are thorough, and the plates are excellent. Dr. Lydekker exercises a healthy conservatism in the matter of species, and a rather greater degree of the same trait in dealing with genera. He is disposed to drop generic divisions whose characters are not of the highest degree of importance. To this course we object, that if we begin to neglect anatomical characters, we end in a disuse of all genera, or in purely arbitrary divisions. The only reason for not regarding an anatomical character as a generic definition, is the inconstancy of that character in the different individuals of the same species. The result of not using such an obvious character as the presence of an additional digit on the fore foot, is seen in the author's treatment of the genus Aceratherium. Having failed to recognize as genera the steps which separate this genus from Rhinoceros, he is now fain to confess that the existence of the intermediate forms "probably indicates that there is really no distinction between Aceratherium (in the sense in which it is used here) and Rhinocerus; although the retention of the former is convenient." We maintain that the same logic will require the union of Orthocynodon and Amynodon to this series, and ultimately of Hyrachyus, the ancestor of the line. We have long been of the opinion that there is no course open to the systematist, other than the recognition of the structural steps by which the stages of the genealogical lines are marked. (See "Origin of Genera," 1868.)

The doctor justly says that the name *Ursus ursinus* is ridiculous. We wish those who write *Mephitis mephitica*, *Sialia sialis*, etc., could take a similar view. The adoption of generic names

[1] Series x, Vol. II, of Memoirs of the Geological Survey of India; Siwalik and Narbada Carnivora. Vol. II. Siwalik Camelopardalidæ, 1883. Vol. III. Additional Perissodactyla and Proboscidia.

which have been published without definitions finds little favor in this work. It is because the names of Bravard are mostly *nomina nuda*, that they are either neglected or ascribed to the author who took them up and clothed them, which was sometimes kindly done by Professor Gervais. The suspicion of cross affinities between hoofed animals and Carnivora is evidently entertained by Dr. Lydekker (p. 239). He says, "It has lately been shown that there are some remarkable indications of affinity existing between certain extinct suina (Achænodon) and the bear-like Carnivora." We hold that such supposed affinity is impossible, and that the only way of tracing the connection between the Artiodactyla and Carnivora is by the way of the Amblypoda and Taxeopoda on the Ungulate side, and of the Creodonta on the Unguiculate side. The real position of Achænodon yet remains to be ascertained.

A supposed species of Hyænodon is described from the Siwaliks. We venture the prediction that the animal (which is only known from an inferior premolar tooth), will turn out to be a member of a different genus and family, and to belong to the true Carnivora. The existence of an upper Miocene Hyænodon must be doubted until fully demonstrated.

Some important additions to this work appear in the appendix as a result of the receipt of the latest publications.

In the memoir on the Camelopardalidæ Dr. Lydekker describes seven species from the Upper Tertiaries of India. These belong to six genera; Camelopardalis, Vishnutherium Lydd., Helladotherium Gaud., Hydaspitherium Lydd., Bramatherium Falc., and Sivatherium Caut. and Falc. Hydaspitherium only, possesses two species from Indian beds. The *Camelopardalis sivalensis* was about the size of the *C. giraffa*, and of similar proportions. Dr. Lydekker follows the authorities in placing the family next to the Cervidæ. Probably the genus Cosoryx is the American and primitive representative of the family. In a foot-note quoting Murie, it is stated that Professor Cope believed that the genus Megacerops is allied to the Sivatherium. This is an error, for it was Leidy who expressed that opinion at the reference quoted. Cope referred it to the group to which it belongs, the Perissodactyla.—*E. D. Cope.*

Geological Notes.—*General.*—R. B. Foote (Mem. Geol. Surv. India) in his notes on the geology of the Madura and Tinnevelly districts, recognizes the following strata, commencing at the surface: 8. Soils and sub-ærial deposits; 7. Blown sands, red (teris), white (coast dunes); 9. Fluviatile and marine alluvia, Kaukas deposits; 5. Sub-recent marine beds, limestones and grits, upraised coral reefs; 4. Lateritic conglomerates, gravels and sands; 3. Gritty sandstones; 2. Gondwana rocks (Jurassic ?); 1. Gneissic rocks. The great hills of red sand in Southeast Tinnevelly

form three or four small fresh-water lakes by damming back the drainage.

In another of the memoirs of the same survey, W. T. Blanford describes the hills on the Sind and Punjab frontier. The recognized strata in Sind are the Siwalik (Pliocene and Upper Miocene), the Gaj (Miocene), the Nari, Upper and Lower (Lower Miocene? Oligocene), the Khirthar (Eocene), the Ranikot (Lower Eocene), the Deccan trap (Transition or Laramie) and limestone with hippurites, probably cretaceous. Two Melanias, a Paludina, and four Unios are described.

Palæozoic.—The first part of the fifth volume of the Palæontology of the Geological survey of New York is devoted to the Lamellibranchiata Monomyaria. The new species described are *Aviculopecten æquilateralis;* six species of Pterinopecten; *Pterinea grandis* and *interstrialis*, *Vertumnia reproba;* eight species of Actinopteria; fourteen forms of Ptychopteria; six species of Leioptera; thirty species of Leptodesma, and three of Mytilarca. All are from the Upper Helderberg, Hamilton or Chemung groups.——S. A. Miller (Jour. Cin. Soc. Nat. Hist.) describes *Palæaster magnificus*, from the Lower Silurian of the Hudson River group, and *Gomphoceras faberi* and *cincinnatiense* from the same group.——U. P. James (loc. cit.), describes a Stromatopora, a Fistulipora and a Cerampora, from the Cincinnati group.——E. O. Ulrich (Jour. Cin. Soc. Nat. Hist.), describes thirteen species of Polyzoa belonging to the genera Rhombopora, Cystodictya, Fistulipora, etc.——Professor P. M. Duncan (Quart. Jour. Geol. Soc.), describes *Streptelasma rœmeri*, a new coral from the Wenlock shale, also *Cyathophyllum fletcheri*, from the same formation.——The report of Messrs. R. Etheridge, H. Woodward and R. Jones on the fossil Phyllopoda of the Palæozoic rocks, enumerates thirty-three genera, with a short diagnosis of each, and gives a full description of Hymenocaris, Caryocaris and Lingulocaris.——Mr. J. F. Whiteaves (Trans. Roy. Soc. Canada) describes and figures some supposed annelid tracks (Gyrichnites), from the Gaspé sandstones.

Silurian.—Ch. Barrois (Ann. Soc. Geol. du Nord 1883), gives notes on the Silurian fauna of Haute-Garonne.

Mesozoic.—M. E. Sauvage (Annales des Sciences Geologiques), describes the fossil reptiles of a bone bed in the Rhetian of the department of Saone-et-Loire. The beds contain also numerous mollusks. The species described are *Rachitrema pellati; Aetiosaurus gaudryi; Ichthyosaurus rheticus* and *carinatus*, and *Plesiosaurus bilraetensis* and *costatus*, all, save the last, new species. The character of the fauna is intermediate between that of the Lias and Trias and the flora is of the same mixed character.——J. S. Gardner (Quart. Jour. Geol. Soc.), contributes a monograph on the British Cretaceous Nuculidæ.——The report of the Geological and Natural History Survey of Canada has a description by J. F.

Whiteaves of the fossils of the coal-bearing Cretaceous deposits of the Queen Charlotte islands. From the upper shales the only species described is *Inoceramus problematicus*. From the coarse conglomerate below the guard of a belemnite is the only fossil yet obtained, but from the lower shales and sandstones nineteen Cephalopoda and seven Gasteropoda, besides Lamellibranchs, are known. The majority of the species are new.——In the Transactions of the Royal Society of Canada, Mr. Whiteaves describes some fossils from the Lower Cretaceous rocks of British Columbia. Though the equivalents of the Upper Cretaceous of Europe have been recognized over a vast extent of country in North America, the Lower Cretaceous, with the possible exceptions of the Dakota group and the Shasta group, has only been recognized during the last seven years by the researches of Dr. Dawson in British Columbia. It is now believed that the equivalents of each of the sub-divisions of the Middle Cretaceous, as well as of the "Neocomien superieur," Lower Greensand, or upper sub-division of the Lower Cretaceous have now been found there. From this formation Mr. Whiteaves enumerates thirteen species of mollusks, three of which he describes as new.

Jurassic.—J. Wohlgemuth (Soc. des Sciences de Nancy), publishes the results of his researches among the middle Jarassic strata to the east of the Paris basin, including the Bathonian, Callorian, Oxfordian, Corallian and Astartian strata. Both upper and lower Oxfordian are recognized.

Cretaceous.—Professor P. M. Duncan (*Geol. Mag.*, Jan.) clears up the ambiguity that has rested upon *Galerites albogalerus* Lam., which, with Loven, he regards as synonymous with *Echinoconus conicus* Breynius. The species is not a toothed echinid, as it has usually been regarded; it has no auricles; the anus is not entirely infra-marginal; and there is no fifth genital plate in the apical system.

Laramie.—M. Neumayr (Neu. Jahrb. fur Min. Geol. und Pal., Stuttgart 1884) notes the parallel position occupied by the Laramie group in Northwest America and the Inter-trappean beds of the Deccan in Hindostan. Both are placed between the Cretaceous and the Eocene, and the resemblance of the fossil fauna is well brought out in the subjoined lists:

NAGPOOR.	LARAMIE.
Physa prinsepi	*Ph. copei*
" " var. *elongata*	*Ph. disjuncta*
Acella attenuata	*Ac. haldemanni*
Paludina virapai	*Hydrob. anthonyi*
Unio carteri	*Unio gonionotus*
Corbicula ingens.	*Corb. cleburni*

Tertiary.—The Palæontological Hand-book of Dames and Kayser, 1883, contains a description of the fossil mammalia of Punin

Ecuador, with a geological treatise by W. Reiss. The species noted are Mylodon (sp), *Equus andium*, *Protauchenia reissii*, new genus and species; Cervus, sp., *Cervus chilensis*, *Mastodon andium* and *Machærodus neogæus*. The authors believe in the total extinction of the horse in America and its reintroduction by the Spaniards.——M. P. J. Van Beneden (Ext. des Bull. de l'Acad. Roy. Belg.), describes some bones of a Sphargis found in brick-earth of the upper Oligocene period. He names the species *S. rupeliensis*. Fossil remains of the leathery turtle have to a great extent escaped palæontologists, and these bony dermal plates have been described as belonging to Ostracion, and have even been associated with Zeuglodon and with Armadillos. Four species of fossil Sphargis are not known, the others being *S. pseudostracion*, *S. psephophorus*, and the Alabama species that was associated with Zeuglodon.——The last number of the Quarterly Journal of the Geological Society contains notes on Brocchi's collection of Subappenine shells, by J. G. Jeffreys. Brocchi Conchologia fossile Subappenina was published in 1814, and was a remarkable work for a time when palæontology was in its infancy. Many of the errors are here eliminated. Mr. Jeffreys concludes that the deposits in which these shells occur were laid down in seas not exceeding fifty fathoms in depth, and states that not the slightest difference can be detected between any of the fossil species in the Pliocene formation which still survive, and their descendants of the present day.

BOTANY.[1]

Notes on Fungi (*Continued from the May number*).—The different species of Polyporus vary much in size. The specimen of *Polyporus berkeleyi* Fr., from which the specimens in North American Fungi were taken, was two feet across and weighed fourteen pounds, while *P. cupulæformis* B. & Rav., is only from one-eighth to one-quarter of an inch in diameter, with pores so fine as to be hardly visible without a lens. The external surface is also very variable. In *P. lucidus* the pileus is of a chestnut red color and smooth as if varnished, while in *P.* (Trametes) *hydnoides*, a subtropical species, the surface of the pileus is thickly clothed with a coat of black stiff bristle-like hairs. A very curious and unusual form of Polyporus is seen in *P. pendulus* B. & C., which grows on the under side or in cavities inside of rotten logs of oak and pine. The pileus is obconic in shape, ¼–½ an inch across, and is *suspended* by a slender stem about half an inch long. When mature it bears a striking resemblance to the basal portion of a tufted specimen of *Hemiarcyria rubiformis* from which the capillitium and spores have disappeared, and being of a similar color to this little Myxogaster it is, at a casual glance, easily mistaken for it. It also bears some resemblance to a small nest of the red

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

wasp hanging from the under side of a dead limb or stick, though the color is different. Still more remarkable is the species found on spruce trees (*P. volvatus* Pk.) in New York, and afterwards on *Pinus contortus* in California by Dr. Harkness. In this species the projecting margin of the pileus is incurved so as almost to enclose the pores, leaving only a small opening, 1/8–1/4 of an inch across. Very similar to this, but probably specifically distinct, is a Polyporus collected in Oregon by W. C. Carpenter, a correspondent of Isaac C. Martindale, of Camden, N. J. In the specimen seen the pores are entirely inclosed and occupy the upper surface of the cavity. The specimen appears to have grown on the upper surface of a fallen tree or perhaps on a horizontal branch. It is oblong in shape, about one and a-half inches long by one inch high and broad, and is of a yellowish color. It appears to differ from *P. volvatus* in its rather larger pores with acute white mouths. The area occupied by the pores also is not so definitely limited, the length of the pores gradually decreasing from the center till the marginal ones are mere points without any appreciable depth. This has been named provisionally *Polyporus inflatus* Ell. & Martindale, but additional specimens and information will be requisite to describe more fully all its characteristic features.—*J. B. Ellis, Newfield, N. J.*

Structure and Physiology of the Passion Flower (*Passiflora lutea*).—The passion flower of Ohio is greenish-yellow, about two centimeters broad, having a crown tinged with purple. From the center of the crown, surrounded at its base by the honey gland, rises the column of stamens, united into a sheath which above again separates into five filaments bearing the anthers. Included by this column of stamens is a stalk which bears the ovary. There are three styles. In case the flower does not set seed it falls off at a joint a short distance below the flower (Fig. 4). In

Fig. 1.

Fig. 2.

Fig. 3.

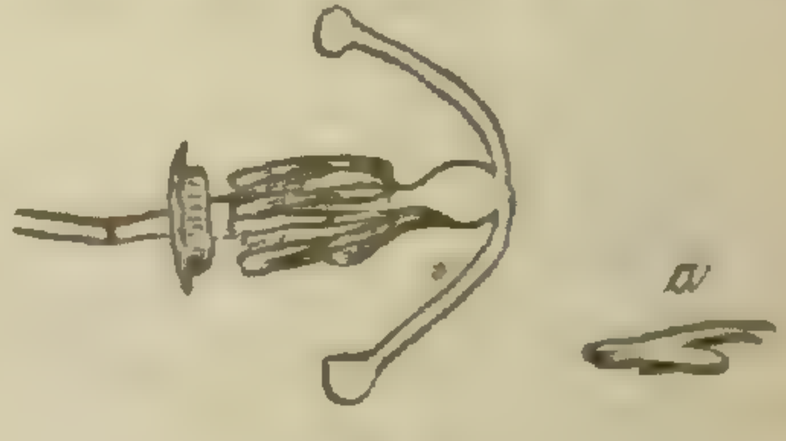

Fig. 4.

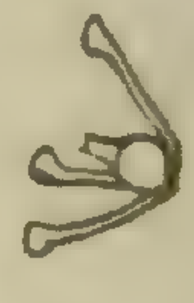

Fig. 5.

Fig. 1.—*Passiflora lutea*, flower in male state. Fig. 2.—Stamens (and styles) just before maturity. Fig. 3.—Stamens at maturity. Fig. 4.—Female state of flower, stamens and styles only represented, *a*, one of the stamens. Fig. 5.—The pistil.

plants grown in my room, none of which were accessible to in-

sects, all the flowers fell off, but in the woods this was not the case. Since my plants were perfectly healthy, I concluded that this flower requires insect agency, and is sterile in case it does not receive it. The structure of the flower also leads to this conclusion.

In the bud both stamens and styles have an upright position, the anthers being intorse (Fig. 2)! The stamens begin to spread out, take a horizontal position and soon begin to recurve. The anthers at the same time become first vertical, *i. e.*, at right angles to the filaments at that time. Then they bend a little further on the filaments, and when these have recurved they appear somewhat as if they had been extorse in the beginning (Figs. 3 and 1). In this condition they are prepared to leave pollen on the backs of visiting insects as they take the honey from the cup-shaped gland surrounding the base of the column of stamens. Then the stamens, having fulfilled their mission, move slowly onward until the anthers are pressed against the column, in which shape they look decidedly as if they had at first been extorse (Fig. 4 *a*). In this shape they are effete, since the pollen must fall on the back of the insect to fertilize the plant. The styles have by this time separated and recurved, and taken the place which the stamens formerly occupied (Fig 4). The styles, however, keep a rather straight appearance when they have once the desired position as represented in Fig. 5. This then is the female state of the flower, and if the stigmas do not receive pollen the flower falls off. This is then a distinct case of proterandry, showing correlative motions in styles, filaments and in the anthers at their place of attachment. I have not found insects upon the flower, but the extreme rarity of the plant in this locality is a sufficient reason. The statements above are enough to show that there must be such visitors. The stigmas never touch the anthers in this species.—*Aug. F. Foerste, Granville, Ohio.*

Conspectus generum Discomycetum hucusque cognitorum. Disposuit P. A. Saccardo.—In this Conspectus the carpological system of classification adopted in the first and second volumes of the Sylloge is applied to the Discomycetes. As the author invites criticism, it will be proper to make a few suggestions:

Instead of adding to Mitrula the colored species of Geoglossum with hyaline sporidia, it would seem more in accordance with the natural affinities of the species to remove from Mitrula to Geoglossum some of the species with clavate or subcylindric heads as suggested by Cooke in Mycographia. It may also be questioned whether it is well to found a genus on *color* alone, as appears to be the case with the proposed genus Microglossum. The propriety of adopting the genus Neolecta is also doubtful, differing as it does from Spathularia only in its globose spores. Helotidium does not seem sufficiently distinct from Helotium, nor does

Pirottæa seem necessary, differing from Mollisia only in its septate hairs scattered over the outer surface of the excipulum.

From the section Hyalodidymæ of Pezizeæ, Bisporella and Lanzia might be removed to Tapesia, Niptera to Mollisia and Helotiella taken back to Helotium, and under Sticteæ, Propolidium might be left under Propolis. To all these changes there can be no valid objection, except the uniseptate sporidia, and it would seem better to disregard this character than to remove these species from that place in the series where all their other characters would naturally seem to place them. For the same reason it would be better not to separate Hæmatomyxa from Hæmatomyces.

These suggestions are made merely as the expression of my opinion and not in any dictatorial spirit, knowing that each must do his work in his own way. Meanwhile, thanks are due to the learned mycologist of Padua for having condensed and made accessible the scattered literature of the Pyrenomycetes in the two volumes of the Sylloge already published, and it is certain that the succeeding volumes will meet with a ready welcome.—*J. B. Ellis, Newfield, N. J., May 13, 1884.*

THE FLOWER OF THE GLADE MALLOW (*Napæa dioica*).—The glade mallow is a diœcious plant. There are usually 15–30 anthers in the male plant, the filaments below being united into a solid column enclosing no styles, as is usual when the column they form is a hollow one. At an early date the anthers, then tinged with purple, burst from the small bud, showing the petals as a mere edging near the border of the calyx. Later, however, the petals grow more rapidly and cover the stamens as is usual

Fig. 1.

Fig. 2.

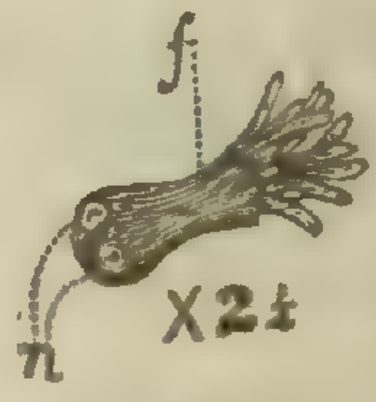

Fig. 3.

FIG. 1.—*Napæa dioica*, male flower. FIG. 2.—Female flower. FIG. 3.—Gynœcium of the same, showing the sterile filaments (*f*) surrounding the styles, also the nectaries (*n*) at their base.

in flowers just before anthesis. The styles never break from the bud in this way, but wait for the expansion of the flower. There are as many styles as there are carpels in the gynœcium, usually 6–10. Surrounding the styles are filaments usually without anthers or bearing small insignificant ones of no value to the plant. These plants are virtually unisexual and female, the male organs being ineffective. The plants, as said above, have the sexes separated so that insect agency becomes necessary for the fertilization of this species. I have noticed a middle-sized wasp effecting this process, but the infrequency with which such visits are carried out, and the few individuals usually found, together with the diœciousness of the flowers, account for the incapability of this plant to compete with ordinary plants in its neighborhood.

A wasp generally starts with one cluster of plants, gathering the honey until it has visited all the flowers it cares to, these are apt to be all of one sex. Then it starts for another, which may happen to be of another sex. If so, its supply of pollen is much too small to fertilize many ovaries, and these visits are not numerous enough to accomplish a full fertilization. Generally but few seeds are capable of germination. The corolla is white, 8^{mm} across. — *Aug. F. Foerste, Granville, Ohio.*

Botany at the Approaching Meeting of the A. A. A. S.—It is desirable on many accounts that there should be a large attendance of botanists at the meeting of the American Association for the Advancement of Science in Philadelphia in September. The location of the meeting is favorable to a larger attendance than ever of those interested in the study of plants, and this, together with the Botanical Club of the Association organized last year at Minneapolis, will, without doubt, bring out many who have not lately attended the meetings. May we not urge upon every botanical reader of the Naturalist that he arrange his affairs so as to be able to attend?

And may we not, also, urge that the botanists who come to the meeting, bring solid and *condensed* papers, both for Section F of the Association and for the Botanical Club?—*C. E. B.*

Erratum.—In the article on Red Clover in New Zealand, on page 629 (June number), line 13 from the top, should read, "That *red* clover does produce its seeds in this colony." The change of one small word entirely changed the meaning of the sentence.

Botanical Notes.—Professor C. R. Barnes records and figures in the May *Botanical Gazette* the occurrence of cork between the annual layers in the stem of *Catalpa speciosa.* It is difficult to account for the presence of cork in such an anomalous position.——Two new species of Rubus (viz. *R. caldesianus* and *R. brachybotrys*), are described by W. O. Focke in the April number of *Nuovo Giornale Botanico Italiano.*——The last number (130) of the *Journal of the Linnean Society* contains articles of unusual interest, several of which we hope to present in summarized form ere long. They are as follows: *Alnus richardsoni*, a fossil fruit from the London clay; On the origin of placentas in the tribe Alsineæ of the order Caryophylleæ; Reproduction of Zygnemaceæ; Structure of the Stem of *Rhynchopetalum montanum;* Development of Starch Grains in the laticiferous cells of Euphorbiaceæ; The Organs of Secretion in the Hypericaceæ.——We have examined the little volume on "Flowerless Plants," by D'Anvers, which constitutes No. IV. of Putnam's "Science Ladders." It would serve excellently in the hands of an intelligent teacher as a reading book for children in the public schools. It is to be regretted that there are so many errors and slips here and there throughout the book. It needs to be re-edited.——The "Times of Linnæus" is the botanical title of an unbotanical book lately brought out by

Jansen, McClurg & Co., of Chicago. It is a pleasantly written romance, but it contains very little about Linnæus, and still less about botany.——Dr. Parry's paper on Chorizanthe, consisting of a revision and rearrangement of the annual species, first published in the Proceeding of the Davenport Academy of Sciences, has been republished in pamphlet form. It is a contribution of great value.

ENTOMOLOGY.

THE TRANSFORMATIONS OF NOLA.—The position of the genus Nola has long been an uncertain one. By some of the older authors, notably Hübner, the species were placed among the Pyralidæ, and Stainton in his Manual of British Butterflies and Moths regards the genus as forming "Family IX, Nolidæ" under the Pyralites, though he says: "One little group, the Nolidæ, is by many recent authors, and perhaps with reason, referred to the Bombycina, being placed with family Lithosidæ." The genus is now generally placed among the Lithosians. In our Synopsis of Bombycidæ we omitted to mention it, partly on account of want of specimens and partly perhaps from supposing it not to be a true Bombycid. Mr. Grote was the first American author to enumerate it in his New Check List of North American Moths, 1884, and to include it among the Lithosiæ.

Having reared *Nola ovilla*, my attention has again been drawn to its systematic position, which seems without much doubt to be properly among the Lithosiæ and near Clemensia.

I have found the larva frequently on the oak in September both in Maine and Rhode Island. Its habit is unmistakably Lithosian; it differs however from Arctian and Lithosian larvæ in having one less pair of abdominal legs, having but four pairs, whereas the caterpillars of the Lithosiæ and Arctians have an additional pair, *i. e.*, ten abdominal legs in all.

When I first discovered the larva of *Nola ovilla* I supposed it to be near Crocota. It was found to be common on the leaves of the oak in Maine, Sept. 6th.

The body is broad and much flattened, rather short, with four pairs of well developed abdominal feet; the first pair being situated on the fourth abdominal segment. The head is not very large, three-fourths as wide as the body; black, with a few paler irregular lines. The body is dirty-whitish, with a dark linear dorsal line, a dark dorsal discoloration behind the head, another in the middle of the body, and a third near the end.

The body is hairy, though not densely so; on each segment are four dorsal tubercles from which radiate short dusky hairs; on the side is a larger and longer tubercle from which arise lateral very long hairs, being as long as the body is broad; some black hairs are mixed with the dirty-whitish ones. The larger and most of the shorter hairs are simple, not barbed, but the shortest, smallest hairs are finely though slightly barbed, the barbules short

The tubercles are dirty-white, concolorous with the rest of the body. Length 13mm.

Sept. 14–16 the caterpillars made singular boat-shaped flattened oval cylindrical cocoons closely attached to the surface of the leaves; they were spun with silk, but covered closely on the inside with bits of oak leaves. The pupa appeared as soon as the cocoon was completed, Sept. 15. The moths appeared May 31 and June 1 of the following year.—*A. S. Packard, Jr.*

An African Social Caterpillar.—At the meeting of the Linnean Society of London, of March 20th, Lord Walsingham exhibited a large and remarkable nest of a species of Anaphe from Natal, containing a packed mass of cocoons, with specimens of the moth and her larvæ. The nest and living larvæ were received in August. Many of the larvæ remained in the nest, but others, in companies of from twenty to forty, occasionally marched out, moving in closely serried ranks, much after the manner of the larvæ of the procession moth. From December to February about 250 moths emerged, but from the difficulty of obtaining their natural food, all died, though a pair bred and the eggs hatched. The mature insect closely resembles the *Anaphe panda* Boisd., though under the latter name, it would seem, there are several well marked local races. The genus is found in West Africa as well as Natal; and it appears that in the several species the color, size, shape, and material of the common nest, as well as the individual silky cocoons, markedly differ. The species of Anaphe have been brought from Old Calabar, Angola, Natal, Gold coast and the Cameroons.

Antennæ of a Beetle used as Defensive Weapons.—The genus Scorpionus (Cerambycidæ) of coleopterists, is so called on account of the peculiar shape of the last joint of the antennæ somewhat resembling the tail of a scorpion. I have met with a number of Brazilian species, all of which are broad, somewhat flattened, very rugose insects; the largest are nearly an inch and a quarter long and half as wide across the elytra. They are nocturnal, or crepuscular, in their habits, clinging to rough barked logs during the day; their rugose forms and sober tints harmonize so well with the surface that they are almost invisible.

While engaged in collecting near Rio de Janeiro, I found one of these beetles clinging, as usual, to the lower side of a log. Seizing it with my forefinger and thumb, I was about transferring it to the collecting bottle, when, to my surprise, it inflicted on me a pretty sharp sting or prick, which caused me to drop it quickly. In defending itself thus, the insect used its antennæ, spreading them out and then throwing them backward and upward with a strong jerk, so as to strike my finger and thumb just behind the nails with the scorpion-like terminal joint. I tried the experiment many times with this and with other specimens, and always with the same result; I have also noticed it in other species of the

genus. The little wound produced by the insect caused a slight swelling and irritation, much like a mosquito bite, for an hour or two. Possibly this arises from a poisonous exudation from the surface of the joint; so far as I can discover there is no true poison gland.

I have never heard nor read of any case where the antennæ of insects were used as defensive weapons, and the fact appears to me to be of much interest. Many beetles have antennal spines which are perhaps used for a like purpose. Certainly the femoral spines of allied species are defensive arms, and pretty formidable ones, as every entomologist knows who has tried to catch the insects with his fingers. So are the thoracic spines of many Cerambycidæ, the femoral spines of certain large moths, the cephalic and thoracic horns of Scarabæidæ, and so on.—*Herbert H. Smith*

Polymorphism of Male Lucanidæ.—At the meeting of the London Zoölogical Society for Dec. 18, 1883, Dr. F. Leuthner read an abstract of a memoir which he had prepared on the Odontolabini, a sub-family of the coleopterus family Lucanidæ, remarkable for the polymorphism of the males, while the females remained very similar. The males were stated to exhibit four very distinct phases of development in their mandibles, which the author proposed to term "priodont," "amphiodont," "mesodont," and "telodont." These forms were strongly marked in some species, but in others were connected by insensible gradations, and had been treated as distinct species.

Report of the Entomologist of the U. S. Department of Agriculture for 1883.—Professor Riley's report is shorter than his last year's, the limits being so restricted as to somewhat modify the original plan of the report and oblige him to omit a report on insects injurious to the cabbage, except mention of those caterpillars more specially injurious. The special agents in the Southwest are the same as the year previous. Professor A. S. Packard, Jr., supplies a report on the causes of the death of the spruce, fir and larch in northern New England, illustrated by two plates, one color showing the transformations of *Nematus erichsonii* and of *Tortrix fumiferana*, *Gelechia abietisella*, n. sp. and *Nematus ventricosus* Say, which lives on the spruce. Mr. H. G. Hubbard has continued his work at Crescent City, Florida, where he is studying the insects affecting the orange, and reports on experiments on scale insect insecticides. Mr. Bruner made in the summer of 1883 an extensive journey from New Mexico to Montana seeking facts relating to the Rocky Mountain locust. Among the other collaborators of the Entomological Bureau are Dr. S. W. Williston, who is working up the Syrphidæ and Tachinidæ, two families comprising insects so useful to the farmer; and Mr. John B. Smith, who is engaged on the insects injurious to the hops and cranberry, as well as a monograph of the Noctuidæ.

Besides notes on the silk-worm industry, insects injurious to

the cabbage, the imported elm-leaf beetle is noticed at length, as well as the lesser locust (*Caloptenus atlanis*) which was destructive last summer in New Hampshire. The account of experiments with insecticides and the machines devised and figured by Dr. Barnard render the report one of high practical interest.

Entomological Notes.—J. Chalande in an article on sensibility in blind cave-beetles (Anopthalmus) in the Bulletin of the Toulouse Society (XV, 1882), concludes with Piochard de la Brulerie, that their sensibility resides in their hair and is proportioned to the amount of this covering. The species of Anopthalmus are less exclusively cave-frequenting insects than has been supposed. In the United States, on the contrary, no Anopthalmi have been found out of caverns.——The insects affecting the strawberry are described by S. A. Forbes in a chapter of fifty-two pages in the Transactions of the Wisconsin State Agricultural Society, Vol. XXI.——E. Hoffer has published a paper on the habits of European humble bees (M. T. Ver. Steierm, 1881, Zoöl. Record for 1882), in which he states that the old queen lays eggs which produce all sexes; those of the so-called small females produce only females and workers. He also speaks of the trumpeter, who rouses the nests in the morning.——According to Dimmock (*Psyche*, III, 392), Witlaczil (Arbeiten Zool. Inst. Wien, 1882, 1–45), maintains that the so-called honey dew of Aphides exudes from the vent, rather than the cornicles. Dr. H. D. Walker takes the same view in his "Notes on Aphides" in Bulletin of the Buffalo Naturalists Field Club, I, No. 6, remarking that the cornicles "have generally been regarded as furnishing the honey dew of which the ants are so fond. This, however, I am satisfied from many observations, is not the case. The honey dew is simply the natural excretions of the insect. I am not aware that the use of these tubes is positively known." In the same article Dr. Walker notices pulsating organs in the legs of Aphides, like those described by Mr. Locy in the aquatic Hemiptera.——James Winters, a farmer, was stung to death by buffalo gnats near Helena, Arkansas, last spring. While he was at work in a field, the gnats swarmed up and enveloped him. Their stings becoming unbearable, he started for home at full speed. All remedies failed to relieve him, and he died in a short time in great agony, his face and neck having turned almost black. This is taken from a reliable newspaper exchange. The buffalo gnat is a species of Simulium, or black fly. They have been known to worry horses to death. (See Naturalist, Vol. II, p. 590).——Sir S. S. Saunders, who died April 15, was an English entomologist well known for his thorough work on the Strepsiptera and fig-insects.——It seems that the Ray Society has acquired the drawings of the late Wm. Buckley of British caterpillars and his voluminous MSS. for publication. They will probably form the subjects for three or four volumes. Those entomologists (not already members of the Ray Society),

who wish to obtain these volumes, should send in their names to the Secretary, Rev. T. Wiltshire, 25 Granville Park, Lewisham, London, S. E., England. We regard the publication of these sketches and descriptions as a great boon to American entomologists, in default of good figures of native larvæ.——At the meeting of the London Entomological Society, October 3, Mr. Wailly exhibited a Samia allied to *S. cecropia*, and possibly a hybrid between it and some other (unknown) species.——"The Butterflies of Maine" by Professor C. H. Fernald, is rich in new facts regarding the distribution and habits of these insects. It is rather startling to read of the occurrence of *Chionobas jutta* at Orono and of *Terias lisa* in the Isle of Shoals, *Euptoieta claudia* near Portland, and *Junonia coenia* near Bangor. Sixty-nine species are enumerated.——Dr. Heylaerts has nearly ready for publication a monograph of the Psychides of the world. In the *Compte-rendu* of the Entomological Society of Belgium, besides notes on European species, he describes four new species from the Argentine Republic, and also a new Cossus-like genus from Chirequi, under the name of *Romanoffia imperialis*.——In his paper on North American Papilionine and Nymphalinine caterpillars published in the Jena *Zeitschrift*, Professor A. Gruber carries on the work begun by Weismann in his great work on seasonal dimorphism, and describes and figures five stages of the larvæ of *Papilio asterias* and five of those of *P. turnus*, five of *P. troilus* and four of *P. ajax*, and five of *P. philenor;* of the Nymphalines four stages of *Melitæa phaëton*, three of *Melitæa marcia*, three of *M. nycteis*, two of *Argynnis myrina*. The paper closes with some general remarks; it will greatly interest American lepidopterists. The sketches alone tell a striking story.

ZOÖLOGY.

THE LIFE-HISTORY OF THALASSEMA.—Mr. H. W. Conn publishes, in the studies from the Biological Laboratory of Johns Hopkins University (Vol. III, No. I), an abstract of his researches on the early stages of this Echiurid worm. The species under observation he regards as new, and mentions it under the name of *Thalassema melita;* it is of a dull red color, with a light yellow preoral lobe. It has the habit of seizing upon empty sand dollars and making its home in them. It enters the mouth of the shell while very small, but once within it grows to a considerable size, and remains the rest of its life a prisoner.

The most important points observed are the following:

1. The origin of the ova and spermatozoa as modified peritoneal cells; their growth in the body-cavity, and their preservation in a sexually mature condition in the sexual pouches.

2. Protrusion of two polar globules exhibiting a rhythm precisely similar to that of the segmenting ova.

3. Segmentation, which is, exceptionally among Annelids, perfectly regular.

4. Formation of gastrula by a typical invagination.

5. The early appearance of a preoral band of cilia and its subsequent disappearance and replacement by a *row* of longer, more powerful cilia.

6. The transformation of the gastrula into a trochosphere by a peculiar method of growth.

7. Origin of mesoderm as two-fold, and the segmentation of mesodermal bands.

8. Origin of ventral nerve chord from the ectoderm as a bilateral structure.

ANATOMY OF THE STOMACH OF STALK-EYED CRUSTACEA.—This subject, lately treated by E. Nauck, is being discussed in a more extended manner by F. Mocquard in the *Annales des Sciences Naturelles*. As is well known the stomach of the Decapoda is armed at the pyloric end with numerous calcareous pieces which project into the cavity and constitute, in the author's opinion, a powerful apparatus for the trituration of the food, while the membranous invaginations give rise to a more or less complicated valvular system. Nauck, who published his paper in the *Zeitschrift für wissen. Zoologie*, described the gastric skeleton alone of the crabs, but Mocquard extends his investigations to all the stalk-eyed Crustacea, and also studies the muscles and stomachic nerves. The figures already published appear to have been carefully and clearly drawn. Meanwhile, F. Albert has an illustrated article on the same subject in the *Zeitschrift für wissen. Zoologie*, published Dec. 21, 1883.

THE CRAYFISH NOT DIMORPHOUS.—It has long been supposed that the species of Cambarus were dimorphous, there being two sets of males, differing mainly in the shape of the first pair of abdominal appendages. But in a paper published in the *American Journal of Science* for January, Professor Walter Faxon states that he received a lot of living *Cambarus rusticus* from Kentucky, males of the "first form" and females, which bred freely in confinement. After pairing, three of the males moulted. These soft-shelled individuals were found to be of the "second form;" their exuviæ of the "first form!" After attaining the "first form" and after pairing, the same individual has reverted to the "second form." It is now clear that we are not dealing with a case of true dimorphism, such as is well known among insects and plants, but it appears probable that the two forms of the crayfish are alternating periods in the life of the individual, the "first form" being assumed during the pairing season, the "second form" during the intervals between the pairing seasons. It is to be inferred that before the animal is again capable of reproduction, another moult will bring it again into the "first form." Professor Faxon observed the same fact in *C. pro-*

pinquus, a male specimen having been taken in the act of moulting. Faxon adds, that "such a change as this connected with the reproductive period is unparalleled, so far as I know, among the invertebrata; and even among the vertebrata, the cases of partial atrophy of the generative organs or shedding of antlers (as in the stag) after the rut is over are hardly comparable."

THE GLOTTIS OF SNAKES. — In the January number of the AMERICAN NATURALIST, Dr. C. A. White, of the National Museum at Washington, gave some highly interesting illustrations of the peculiar structure of the epiglottis that he had observed in the bull snake (Pityophis), and to which he attributes the loud, hoarse, "bellowing" sort of "hiss" for which this snake is remarkable. The individual which he examined is still alive, occupying a distinguished and exclusive position with two or three other snakes at the museum, and it amiably submitted to have its mouth held open while Dr. White kindly exhibited to me the very singular character of its epiglottis. It differs so obviously from that of any other snakes which I have had an opportunity of examining, that I venture to offer a few words to describe my own observations.

Dr. White thinks that as in snakes there is no comminution of food, any protection of the aperture of the wind-pipe in swallowing is unnecessary. In Pityophis the permanently erect position of what represents the epiglottis would certainly appear to be a sufficient protection, but in some others that I have watched while feeding (for the wind-pipe is often so far forward as to be easily observed), the glottis is closed tightly and remains closed, except when occasionally opened as if for the purpose of respiration and closed again; and the action appears to be entirely volitional, not regular, but as occasion requires. The impression imparted to the observer is, that the action is protective also; there is a sensitiveness and nervousness, so to speak, about the contracting and expanding orifice, as if the snake were guarding against the entrance of dust or any foreign substance while the trachea is in this exposed position, opened to breathe only, and quickly closed at will. When at rest and the snakes are not feeding, we see the anterior part of the windpipe lying along the mouth, somewhat in the form and position of a parrot's tongue; and in some small snakes you may occasionally discern the cartilaginous rings of the trachea through the delicate membrane. The orifice in those snakes that I have watched appears to be of a more simple construction than in Pityophis, and the epiglottis described and illustrated by Dr White is either entirely absent or represented only by a slightly developed lip or valve at the lower part of the orifice, and called by Duméril a *petite languette*, which assists to more thoroughly close the glottis.

Dr. White informs me that he has not watched Pityophis while

feeding, and cannot, therefore, tell whether the trachea protrudes from the mouth or not at that time. I hardly see how it can, with this stiff, erect barrier immediately in front of it to guard the opening, as when Dr. Yarrow and myself saw it expand. Indeed this protrusion of the trachea in snakes appears to be but little known; for notwithstanding their abundance in the woods in America, you do not often come upon a snake feeding, and zoölogical collections are at present few and far between. Nor does a snake invariably require to breathe while swallowing. During the many hours I have spent in watching the snakes on feeding days at the London Zoölogical Gardens, week after week for several years, I have seen the trachea protrude from the mouth perhaps once in a dozen meals. When the food is quickly and easily swallowed, the supply of air in the lungs is sufficient for the time; but should the prey be unusually bulky or awkward to manage, completely gorging the mouth, it may occupy a longer time to swallow, when to breathe afresh becomes requisite, and the difficulty is met by this adjustable wind-pipe. Not unfrequently a snake is an hour or more swallowing large-sized prey, during which time the mouth and throat are stretched to their utmost capacity, and then you may see the trachea projecting a full inch in the larger kinds. In chap. VIII of my work on "Snakes" I have entered more fully into the subject than space will here permit. Professor Owen describes the apparatus as the *glottis*, other writers speak of it as the *larynx*, while others again simply state that the *wind-pipe* may project beyond the mouth. I have observed it in the large oriental constrictors, the rattlesnakes, several of the African vipers, and even in some small snakes, as, for instance, *Heterodon d'orbignii* and the English ring snake; who in both cases were swallowing an inconveniently large frog, and the trachea was sufficiently forward to show the contracting and expanding action of its orifice. We hope to persuade Pityophis to partake of a meal while we are watching him, when there may be further observations to record. —*Catherine C. Hopley.*

Abnormal Deer Antlers from Texas.—The accompanying photographs of the skull and antlers of a deer were sent me from San Antonio, Texas, by Dr. Mortimor Slocum, with the information that the deer was killed by a hunter named Havey, on the Neuces river, about one hundred miles west of San Antonio, in August last, while the velvet was yet on the antlers; that the deer weighed 180 pounds, and that a companion was with the deer with antlers precisely the same as these. These antlers are fourteen inches long, and eight and a quarter broad, with seven points at each of the ends, and both are very much alike. This is the sum of the information given me of these remarkable antlers, and I am requested to classify the deer specifically.

These antlers are now in the collection of Mr. Dosch of San

Antonio. I examined this collection several years since, and must pronounce it the finest collection of deers' heads and antlers I ever saw anywhere; most of these were well mounted, and well arranged. Nearly all are of the common deer (*Cervus virginianus*) and taken in Texas; but there were one or two of the mule deer (*Cervus macrotes*) which I was informed were also taken in Texas.

With the limited information before me it is not easy to classify this specimen with absolute certainty. If I had but the tail or the skin of a hind leg I could classify it with as much certainty as if the whole animal was before me, for these are so nearly alike on every individual of each species and so unlike every other species as to be absolutely reliable, so far as my observations have extended.

The first inquiry which naturally presents itself is, are these antlers of the form and position of any known species of deer in America? The palmetation first attracts our attention. We have three species of deer in America, which have habitually and distinctively palmetted antlers, the moose (*Alces*) and the two species of caribou (*Tarandus*).

These antlers most resemble that of the moose, being broadly palmetted, with points or spurs on their upper borders, but in position they are entirely unlike those of the moose. The antlers of the moose are projected from the head in a nearly horizontal position, sometimes a little depressed, and sometimes a little elevated, the latter position being more frequently observed on the young animal. The palmetation does not become pronounced till after he is four years old.

The position of these antlers appears to be approximately vertical, spreading, possibly, thirty degrees from the vertical.

Not the rudiment of a basal snag is formed on the antler of the moose. On these antlers the basal snags are large.

The form of these antlers differs still more widely from those of the caribou. These always have distinctive beams with long prongs which are liable to be palmetted at the ends, but the most distinctive characteristic is the brow tines which project downward over the face, with broad vertical palms at the ends, with spurs or fingers which approach each other, and which sometimes interlock like the fingers of two hands.

Indeed there can hardly be said to be a resemblance between the antlers under consideration and those of the caribou.

But if the resemblance to either were never so striking, the latitude in which the animal was found would forbid the suggestion of a relationship to either the moose or the caribou. All of these are boreal animals, occupying high northern latitudes. Maine and Montana may be considered the extreme southern limits of their habitat. I have seen fossil remains of the moose found as far south as Chicago, and I have met with statements that they have been found as far south as the Ohio river, but the live animals have not occurred in these regions within the historic period.

We may safely conclude that this deer is not a relative of any of the known species of deer which have habitually palmetted antlers. By no accident, or stress of circumstances could any of these northern species have been found as far south as Texas, and that, too, in the summer season.

Is it a new species hitherto unobserved with normal antlers like these? If a distinct species, it must be more or less numerous and habitual either in the region where it was found or in some other region whence it was possible for it to have wandered.

Now, this entire continent has been so thoroughly worked over during the last half century by competent naturalists, to say nothing of more numerous hunters, who do not overlook anything new or unusual, that so large and so distinctive an animal as this could not possibly have escaped observation. We may expect to find new species of birds whose habits are migatory, or possibly some small and nocturnal quadrupeds, but so large an animal as this deer, with antlers so peculiar and distinctive as to attract the attention and even wonder of every beholder, could not have escaped detection. It is impossible to believe that there is a whole race of animals anywhere on this continent habitually wearing such antlers as these, else they would have been seen before somewhere. We are forced, then, to the conclusion that this deer was not the representative of a new species of deer, but an individual of some well-known species, with peculiar and abnormal characteristics confined to the individual. But Mr. Havey says, there was a companion to this deer, with antlers precisely like these. Well, two bucks will not make a species, but may there not possibly be some error in this observation? Had he killed the other buck also, and critically compared them when lying side by side, we might not question the accuracy of his observation, but his view must have been taken when the deer was in life, standing at a greater or less distance off or when running, and whether there were intervening objects to impair the value of his observation we are not informed.

We need further information before we can determine what value we can place upon the opinion that both sets of antlers were precisely alike.

I am clearly of opinion that these antlers are of an abnormal growth, probably induced by some accident or violence inflicted upon the pedicels of the antlers, or upon the antlers themselves while growing in their early stages. Such accidents and consequently abnormal growths are not very uncommon. At p. 226 of "The Antelope and Deer of America," I give an illustration of the antlers of a common deer, showing as wide a departure as these from the normal type though of an entirely different character. That growth was undoubtedly induced by violence done to the antlers in the early stages of their growth. In that

case as in this, the injury was to both alike and doubtless at the same time.

Evidence of a serious injury to this deer is not wanting, even in these photographs. In the side view we distinctly see a pronounced disfigurement in the nose or face below the eyes, or what we call in a horse a Roman nose. Now this never occurs naturally in any of the deer family, and so we may safely conclude that this deer had suffered serious violence in or about the head, and this I think the most probable explanation of the cause of these abnormal growths of the antlers.

This deer must have belonged to one of two species of deer. The Virginia deer is the most common species in that part of

Antlers of a deer shot in Texas.

Texas where this deer was found. The mule deer is occasionally met with in Texas, though its occurrence is not very common. If the ears were small, the tail flattish and of a lanceolate form, and covered with white hairs on the under side and edges, and the naked black portion, covered with the reversed hairs which overlay the metatarsal gland on the outside of the hind leg, was not much more than one inch long and surrounded by a border of white hairs, then we should know certainly that it was a common Virginia deer though of twice the average size of this deer in Texas. If the ears were very large and heavy, the tail round and naked on the under side, covered else with white hairs except a black switch or tuft at the end, and if the naked black portion over the metatarsal gland was three or four inches long with no

white hairs about it, then we should certainly know it was a mule deer. These tails are illustrated in the work above referred to, on p. 234, and the glands on p. 254. But these indicia of species are entirely wanting, and we only have a picture of these abnormal antlers to enlighten us. If the antlers were normal we might determine the species with considerable confidence.

The antlers of the common deer are usually less spreading than those of the mule deer, though not always so, and in this respect these answer best to the former, though their position may have been altogether changed by the accident. The strongest evidence to show that it was a common deer I see in the basal snag near the butts of each antler; these are very large and both bifurcated. This snag is always present on the normal antler of the Virginia deer, and is usually present on that of the mule deer, but is very much smaller on the latter than on the former.

On the common deer this member is frequently bifurcated on large old specimens but never on the mule deer, though on large specimens we frequently see a rudimentary branch, but I have never seen anything like an equal bifurcation or even a fairly developed tine. But the bifurcations of these prongs are not as we see them in the natural growth. The prong divides into nearly equal parts very near its base and these separate at angles of seventy degrees or so. In the few cases where I have seen the basal snags fairly divided into approximately equal parts, the forks have grown up nearly parallel, but when the antler itself is so disfigured as this we should not expect any member to be in its natural form. It is the unusual proportionate size of this nasal snag which inclines me to attribute the specimen to a Virginia deer.

The size of the deer suggests a larger species than the common deer, which, as already suggested, is very considerably smaller in Texas than in higher and colder latitudes, but I have no doubt still larger specimens than this is claimed to be are occasionally met with in that country.

The mule deer is an appreciably larger species than the common deer, and hence, the large size of this specimen suggest this deer, but I can point out no other evidence which strongly indicates the mule deer; while the rarity of this species in the country where this was killed, and the abundance of the common deer suggests the latter as most probable.

I would give something for the ear or the tail of this deer that all doubts might be resolved; as it is I cannot tell to which of these two species this deer belonged from the mere picture of a damaged head and antlers of an unnatural growth. It is easier to tell what it is not.—*J. D. Caton.*

[*Note by the Editor.*—The case above cited by Judge Caton is paralleled by a similar one which came under my observation

several years ago. A large and highly colored buck of the *Cariacus virginianus* was shot in Central New Jersey, in which the horns of both sides were completely and symmetrically palmated as in the moose. This modification of horns of Cariacus is just what is to be expected in accordance with law of "acceleration," and constitutes an actual transfer of such modified individuals to the genus Alces. The genera Alces and Cariacus agree with other American deer in the absence of the brow antler, and Alces stands at the head of the series by virtue of its palmation If a similar change were to take place in a true deer of the genus Cervus, the result would be a Dama, a genus which agrees with Cervus in the possession of a brow antler, and differs from it as Alces does from Cariacus, *i. e.*, in its palmation. Instances of this kind show the correctness of the position I took in 1868,[1] that the change of generic characters is independent of that of the specific, and that one species may come, by acceleration in some of its individuals, to belong to two genera.—*E. D. Cope.*]

Forsyth Major on the True Pigs.—In the *Zoologischer Anzeiger*, June, 1883, the above well known palæontologist gives an account of the recent species of true pigs with their extinct connections. He limits the existing species to three: *Sus verrucosus* M. and S. (Java, Celebes), *S. barbatus* M. and S. (Borneo), and *S. scrofa* L. He regards the *S. vittatus* M. and S. as a form of *S. scropha*, and finds that it has seventeen synonyms. These often represent minor variations of character, which do not form constant combinations. They are, as a whole, characteristic of immature conditions of the *S. scropha* of northern regions. Forsyth Major regards the *S. vittatus* as the primitive form. The *S. verrucosus* is nearly related to the *S. giganteus* Falc. of the Siwaliks, and the *S. strozzii* Menegh. of the Val d'Arno.

Zoölogical Notes.—*Mollusks.*—H. L. Osborn (Stud. Biol. Lab. J. Hopk. Univ.), gives the results of his studies of the gills of some prosobranchiate mollusca. Starting with the statement that the researches of Peck and Mitsukuri have made it tolerably clear that the highly complicated gills of some lamellibranchs are derivable from a simple series of folds of the body wall, he summarizes thus: "The gill of Chiton and Fissurella is closely like the ctenidium which Lankester considers the primitive type of molluscan gill. In ctenobranchs, almost universally, the gill is not a ctenidium, but a very much simpler organ. Its form compares closely with the gill which we have come to regard as the primitive lamellibranch gill." He inclines to the belief that the lamellibranchiata are degraded from cephalophorous ancestors, while their highly complex gills are due to "the sessile habit of the animal throwing upon the gills sundry functions besides those of the gill proper.

[1] In "The Origin of Genera."

Crustacea.—H. W. Conn (Studies from the Biological Laboratory, Johns Hopkins Univ.), contributes some thoughtful observations and suggestions upon the signification of the larval skin with which the decapod zoea is covered on emerging from the egg. The apparent anomaly that certain low Macrura possess larvæ with a thorax, while the Schizopods have a zoea without a thorax, is explained by the assumption that the zoea stage is an intercalated adaptive form with the body shortened to enable the larva to swim better, while the protozoea, represented by the zoea of Penæus, is the ancestral form. By substituting the Protozoea for the Phyllopoda, Mr. Conn seeks to reconcile the classification of Boas with that of Packard, and with the teachings of embryology. ——Professor Greeff (Sitz. Ges. Natur. Marburg, 1882), gives an account of the land and fresh-water crabs of St. Thomas and Rolas, in the Gulf of Guinea. *Gecarcinus ruricola*, known from the West Indies, occurs also in incredible numbers in the Guinea islands. It is found even in the mountains, under stones, in holes in the earth, and other damp places. *Cardisoma guanhami*, another Antillean species, occurs with the former. *Cœnobita rugosa* is common all over St. Thomas, and causes a great mixture of marine and fresh-water shells. During their growth the crabs wander inland, taking with them Murices, Bullidæ and other marine forms. Arrived at the mountains, 800 meters above the ocean, they exchange these for Helix and Achatina in which they travel to the coast. The fresh-water species are *Palæmon olfersi*, *Atya scabia* and *Thelphusa margaritaria*.

Fishes.—On account of the possession of a drag-net adapted for the purpose, the *Talisman* was more fortunate than any previous exploring vessel in obtaining examples of deep-sea fishes. At one haul in 16° 52′ N. lat., and 27° 50′ W. long., and at a depth of 450 fathoms, no less than 1031 specimens were taken. The greatest depth at which a fish was obtained was 4255 meters, and the fish was *Bythites crassus*. Some of the species appear to inhabit very extensive zones of depth, thus *Alepocephalus rostratus* ranges from 868 to 3650 meters, *Scopelus maderensis* from 1090 to 3655 meters, *Lepioderma macrops* from 1153 to 3655 meters, and *Macrurus affinis* from 590 to 2220 meters. This great range appears to indicate a power of adaptation to the pressure of the water. Among the phosphorescent apparatuses found in these denizens of the deep, one of the strangest is that of *Eustomias obscurus*, a slender fish with a large mouth. From the under side of the chin depends a long filament ending in a rayed knob which is highly phosphorescent.——A. Cocco (*Il Naturalista Siciliano*), contributes some interesting notes on *Trachypterus cristatus* Bonelli, and describes it from an example 132 millimeters long, taken in the Straits of Messina. The six rays of the first dorsal greatly exceed the body in length.——G. Seguenza (*loc. cit.*), notices the occurrence of *Rhinobatus halari* in the seas

of Sicily. The species was described by Ruppel from the Red sea, but has been taken at Palermo and on the Algerian coast. It attains the length of six feet.——The Marchese A. De Gregorio (*Il Nat. Sic.*, March), continues his notes on the Jurassic corals of Sicily, and describes four new species.——Miss Rosa Smith (Bull. Col. Acad. Sci., 1884), describes *Squalius lemmoni*, discovered by Mr. J. G. Lemmon in Rillito creek, near Tucson, Arizona.——Professor Greeff (Sitz. Ges. Natur. Marburg) describes *Gobius bustamentei* from St. Thomas.

Reptiles.—Dr. Strahl (Sitz. Ges. Bef. Natur. Marburg, 1882–83) describes the development of *Lacerta agilis*, *vivipara* and *viridis*, especially of the latter. The allantois, the changes in the ovum and the formation of the vascular system in the germinal disk, are given at length.

Mammals.—Professor Lieberkuhn (Sitz. Ges. Natur. Marburg, 1882), gives the results of his researches into the development of the ovum and embryo of the porpoise; and in the same proceedings, 1883, discusses the formation of the medullary canal in mammals generally.

PHYSIOLOGY.[1]

Coloring Matters of Bile.—C. A. MacMunn is led by his observations to dispute a generally accepted view that the liver of invertebrates is nothing more than a pancreas in function; the most striking outcome would seem to be the discovery of the wide distribution of a coloring matter, which is beyond doubt a chlorophyll pigment; this it is proposed to call entero-chlorophyll. The author has chiefly relied on the evidence afforded by the spectroscope, for, as he points out, it is useless to expect that the chlorophyll in the state in which it occurs should be capable of developing oxygen in the presence of sunlight in the livers of Mollusca, or in the pyloric cæca of star-fishes, &c. The new body would appear to differ from plant-chlorophyll in that treatment with nitric acid makes the solution slightly greenish, although previously it may have been yellow. This is explained by the view that the pigment is in a more or less reduced condition, "probably due to the action of a ferment on the chlorophyll, or to the fact that it is sometimes present in the form of a radical or chromogen."

Spectroscopic measurements show that the liver of the oyster contains a coloring matter which, when treated in alcholic solution with nitric acid, gives the same spectrum as a similar solution of leaf-green when treated with that reagent. A large number of other Mollusca have been examined.

Among the Arthropoda, Crustaceans have alone been studied: in the common crab enterochlorophyll was rarely, but lutein con-

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

stantly found; in the crayfish there was abundance of hæmatin in the bile.

The pyloric cæca of star-fishes were found to function as a so-called liver; that is to say, they not only seem to prepare a digestive ferment, but they serve as organs for the storing and probably for the actual production of pigments for surface coloration; enterochlorophyll is here also found.

Hæmochromogen, which is found in the bile of the crayfish and of the Pulmonate Mollusca, is apparently due to an animal's mode of life, and does not seem to be "distributed according to morphological considerations."

It is as yet too early to speak definitely, but there is much evidence to show that enterochlorophyll is synthetically formed in the body of its animal possessor.

The second and third portions of this important paper deal with the vertebrate bile pigments, and some unusual urine pigments; the latter should be of interest to the physician as well as to the physiologist.—*Journ. R. Micr. Society, Dec., 1883.*

PSYCHOLOGY.

Darwin's opinions on Instinct.—A posthumous essay on "Instinct," by the late Charles Darwin, was read on December 6th, at the Linnean Society, before a very large and distinguished audience of fellows. The paper, which treated of the instincts of animals, and the bearing of the subject on the theory of natural selection, was originally written for the "Origin of Species," but never published. It discussed the migration of birds and mammals, and after narrating a great series of curious facts, concluded with the inference that though there were many aspects of the question which admitted of no immediate explanation, the migratory instinct was inherited from ancestors who had to compass (for the sake of food or other causes) long distances, when the conditions of land and water were different from what they are at present. He then considered how the more remarkable migrations could possibly have originated. Take the case of a bird being driven each year, by cold or want of food, slowly to travel northward, as is the case with some birds; and in time we may well believe that this compulsory traveling would become instinctive, as with the sheep in Spain. Now, during the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still he could well believe that the impulse which leads the pinioned goose to scramble northward would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals, and savage men, can retain a true course, it would safely cross the sea now covering the submerged path of its ancient land journey. Animals on oceanic islands, and other localities where they have never met with man or beasts of prey, are devoid of fear. This instinc-

tive dread they subsequently acquire, for their own preservation, and transmit it to their descendants. At the Galapagos islands Mr. Darwin pushed a hawk off a tree with the muzzle of his gun, and the little bird drank water out of a vessel which he held in his hand. But this tameness is not general, but special towards man; for at the Falklands the geese build on the outlying islands on account of the foxes. These wolf-like foxes were here as fearless of man as were the birds, and the sailors in Byron's voyage, mistaking their curiosity for fierceness, ran into the water to avoid them. In all old civilized countries the wariness and fear of even young foxes and wolves are well known. At the Galapagos islands the great land lizards (Amblyrhynchus) were extremely tame, so that Mr. Darwin could pull them by the tail; whereas in other parts of the world large lizards are wary enough. The aquatic lizard of the same genus lives on the coast, is adapted to swim and dive perfectly, and feeds on submerged algæ; no doubt it must be exposed to danger from the sharks, and consequently, though quite tame on the land, he could not drive them into the water; and when he threw them in they always swam directly back to the shore. Animals feigning death seemed to Mr. Darwin a remarkable instinct, but he considered that there was much exaggeration on the subject. It struck him as a strange coincidence that the insects should have come to exactly simulate the state which they took when dead. Hence he carefully noted the simulated positions of seventeen kinds of insects (including an Iulus spider, and Oniscus) belonging to the most distinct genera, both poor and first-rate shammers; afterwards he procured naturally dead specimens of some of these insects, others he killed with camphor by an easy slow death. The result was that in no one instance was the attitude exactly the same, and in several instances the attitude of the feigners and of the really dead were as unlike as they possibly could be. Bird-nesting and the habitations of other animals were next discussed, the general conclusion being that though there are various adaptations of inherited instincts to suit varying circumstances, yet that these variations all tend to preserve the species in the struggle for existence, by conducing to the "survival of the fittest." Although he did not doubt that intelligence and experience often come into play in the nidification of birds, yet both often fail; a jackdaw has been seen trying in vain to get a stick through a turret window, and had not sense to draw it in lengthways; Gilbert White describes some martins which year after year built their nests on an exposed wall, and year after year they were washed down. The *Furnarius cunicularius* in South America makes a deep burrow in mud-banks for its nest; and he saw these little birds vainly burrowing numerous holes through mud-walls, over which they were constantly flitting, without thus perceiving that the walls were not nearly thick enough for their nests. After an exhaustive account of va-

rious traits of instinct, and difficulties in the way of his theory, explaining all of them, the paper closed with the following general conclusion:—"We have chiefly considered the instinct of animals under the point of view whether it is possible that they could have been acquired through the means indicated on our theory, or whether, even if the simpler ones could have been thus acquired, others are so complex and wonderful that they must have been specially endowed, and thus overthrow the theory. Bearing in mind the facts given on the acquirement, through the selection of self-originating tricks or modification of instinct, or through training and habit, aided in some slight degree by imitation, of hereditary actions and dispositions in our domesticated animals, and their parallelism (subject to having less time) to the instincts of animals in a state of nature, bearing in mind that in a state of nature instincts do certainly vary in some slight degree; bearing in mind how very generally we find in allied but distinct animals a gradation in the more complex instincts, which show that it is at least possible that a complex instinct might have been acquired by successive steps; and which, moreover, generally indicate, according to our theory, the actual steps by which the instinct has been acquired, inasmuch as we suppose allied instincts to have branched off at different stages of descent from a common ancestor, and therefore to have retained, more or less unaltered, the instincts of the several lineal ancestral forms of any one species; bearing all this in mind, together with the certainty that instincts are as important to an animal as their generally correlated structures, and that in the struggle for life under changing conditions, slight modifications of instinct could hardly fail occasionally to be profitable to individuals, I can see no overwhelming difficulty on our theory. Even in the most marvelous instinct known—that of the cells of the hive-bee—we have seen how a simple instinctive action may lead to results which fill the mind with astonishment. Moreover, it seems to me that the very general fact of the gradation of complexity of instincts within the limits of the same group of animals, and likewise the fact of two allied species, placed in two distant parts of the world, and surrounded by wholly different conditions of life, still having very much in common in their instincts, supports our theory of descent, for they are explained by it; whereas if we look at each instinct as specially endowed, we can only say that it is so. The imperfections and mistakes of instinct, on our theory, cease to be surprising; indeed, it would be wonderful that far more numerous and flagrant cases could not be detected, if it were not that a species, which has failed to become modified and so far perfected in its instincts that it could continue struggling with the co-inhabitants of the same region, would simply add one more to the myriads which have become extinct. It may not be logical, but to my imagination it is far more satisfactory to look at the young

cuckoo ejecting its foster-brothers, ants making slaves, the larvæ of the Ichneumonidæ feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies—Multiply, vary; let the strongest live and the weakest die."

DREAMING IN VERSE.—Having a turn of mind for rhyming, I had frequently dreamed in verse. On one occasion my husband heard me repeat distinctly two lines in verse. He asked me very gently, "What is the next line?" I replied, in my sleep, "You guess the next line, and I will tell you the last." His merry laugh awoke me and, curiously enough, I could not recall my dream or the lines which I had spoken aloud.—*Mrs. Prof. T. H. Rich, Bates College, Me.*

ANTHROPOLOGY.[1]

MR. BANCROFT'S NEW VOLUMES.—Scarcely a week passes in which the editor of this department of the NATURALIST is not importuned with some such question as this, "What one work will give me the best account of ancient and modern Mexico and Central America?" To this question there can be but one answer. By far the best and most comprehensive account of that whole region is the monumental work of Hubert Howe Bancroft. We are not now discussing the style of the composition, abounding in metaphors which only show the enthusiasm of the writer. Neither are we saying that the author is always right—he himself, over and over again, admits that his ground is not firm beneath his feet. But looking at the cost, the intricate machinery of research, the painstaking, the unwearied and unswerving attachment to a single aim, and the scrupulous care to give to every man his due, we forget every little shortcoming. Let us dissect Vol. I of the new series. Pages I–XIV contain the preface, in which Mr. Bancroft sets forth the plan of his new series, defines his methods, credits his assistants, throws a lance at historical theorists, and, we regret, defies his critics. Then follows, pages XV–XXIII, analyses of the XXVII chapters into which the volume is divided. From page XXV to LXXII, in his characteristic manner, the author presents a bibliography of Central American literature, in which not less than 2000 titles are given. Some of these are the names of works for which large sums of money have been paid, and all of them have been thoroughly exhausted by the faithful corps of indexers employed by the author. The introductory chapter relates to the condition of Spanish society when Spain began her American conquests. At the close of the chapter is an encyclopædia of information on geographical knowledge and discovery prior to the year 1520

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

pp 67–154. We pass over chapters II–XXII, devoted to the narrative of Columbus and his successors in Darien, Costa Rica, Nicaragua, and Honduras, and come to operations of the Spaniards in the provinces bordering on Mexico. The Quiché empire rose in the XII or XIII century of our era. In the early part of the XV century the Cakchiquels divided domination with them. In their turn the Zutugils separated from the Cakchiquels, having their capitals at Patinamit and Atitlan. The manner of conquest by which Pedro de Alvarado, the lieutenant of Cortez, and his faithful followers destroyed their power and appropriated their country, is the burden of the closing chapters of the volume. "Henceforth," says Mr. Bancroft, "oppression and destruction marched hand in hand over the country, and the result was a national and social eclipse of the fallen races. Their arts and sciences were soon forgotten; their architectural skill was lost; and from a state of happy development their life as a nation was blotted out."

The author designs to devote three volumes to Central America, therefore, in order to bring his Mexican studies along simultaneously, Vol. IV of the series, being the first on Mexico, follows Vol. I. The five periods of Mexican history as discussed by this writer, are (1) the aboriginal annals of Anahuac (Native Races, Vol. V); (2) the conquest of Cortez; (3) three centuries of vice-regal rule; (4) the struggle for independence and the founding of the republic; (5) her subsequent history, internal revolutions, war with the United States, the imperial experiment of Maximilian, and the later development of peaceful industries. For the performance of this work Mr. Bancroft is thoroughly equipped, indeed, no other historian has ever had at his command such resources. Furthermore it is not difficult to perceive that Mexico is the author's pet. The bibliography covers nearly a hundred pages of fine type, and this repeats not one-third of the works consulted. Not all the chapters in this volume are strictly ethnological, from our point of view, although they are certainly anthropological. The interest for the student of the ancient Mexican history commences with Chapter VII, and being resumed at Chapter XIII, continues unabated to the end of the volume.

THE MOUND-BUILDERS.—Some months ago we brought to the attention of our readers a paper, by Dr. Daniel G. Brinton, on the identity of the Mound-Builders and the Choctaws. On Tuesday evening, Feb. 5, Professor Cyrus Thomas, of the Bureau of Ethnology, read a paper before the Washington Anthropological Society with the following title: "Were the Cherokees mound-builders?" Now this is a very different question from that which would ask, "Were the Mound-Builders Cherokees?" Professor Thomas is now the archæologist of the Bureau of Ethnology and made extensive explorations in North Carolina during the past two seasons. These have brought to light two facts: (1) That mounds in the Cherokee region, of identical outward appearance,

have revealed Cherokee and typical Mound-Builder implements, and (2) from both these classes of works have been taken brass, iron, and glass objects. Specimens of all these classes of finds were exhibited at the meeting. About the same time that Professor Thomas read his paper, Professor F. W. Putnam sent us an abstract of an account of his recent archæological excursions in Wisconsin and Ohio, given at the meeting of the American Antiquarian Society, October 22. Comparing the two papers, one could hardly fail to see that a great change of opinion has taken place among our American archæologists concerning the Mound-Builders. Indeed, most investigators would advise us to drop the capital letters. As long, however, as eminent archæologists are troubled to find out who were the Mound-Builders, there is certainly a people called the Mound-Builders that remain to be found out. Now it is precisely this lost people to whom the capital letters apply. That those researches have accomplished much toward dispelling many ancient illusions, no one will dispute. The Mound-Builders probably were not so numerous, so highly organized socially, nor so cultivated as many have held. Neither were their successors within the area of the United States so degraded as they have been made out. The chasm, therefore, so far as culture is concerned, between the two peoples, the Mound-Builders and the modern Indians, has been bridged over by Thomas Putnam and others. No one has ever seen a tribe of homeless nomads on this continent. Mr. Morgan's investigations, followed up more minutely by Mr. Dorsey, have revealed an intricacy of social structure truly astonishing even among tribes called nomads.

Now these discoveries may turn our heads; and we are in danger of running into the other extreme of maintaining that the Mound-Builders were the ancestors of our modern Indians living on the same areas—which cannot yet be proved. That much can be said in its favor, that the attempt to prove it has awakened a lively interest in American archæology, and that the subject is one of legitimate inquiry, no one for a moment can doubt.

On the Athabasca district of the Canadian Northwest Territory.[1]—That which gives value to this paper for the anthropologist is the table of statistics of the Athabasca and Mackenzie redskin population, including women and children.

Great Slave Lake.		
Fort Resolution, 1863–64	Chipewyans	245
	Yellow Knives	332—577
Fort Rae, 1864	Dog-ribs	788
Mackenzie.		
Providence, 1871	Slaves or Etcha-ottiné	300
Blake Lake river, 1878	Etcha-ottiné	115
Hay river, 1874	" "	100
Fort Simpson, 1873	" "	300

[1] By the Rev. Emile Petitot. Map. Proc. Roy. Geog. Soc., 1883. Nov., pp. 633–655.

Mackenzie.

Forts Norman and Franklin (Bear lake), 1869....	Slaves or Etcha-ottiné	97	
	Dog-ribs	47	
	Mountain Indians	43	
	Hareskins	85	272
Fort Good Hope, 1867.....	Hareskins		422
Fort Macpherson (Peel R.), 1866, including La Pierre's House	Dindjie or Loucheux Quarrelers, Kutchin		290
	Eskimo of the Anderson	250	
	Eskimo of Mackenzie	300	550
Forts Leard and Nelson	Slaves		500
Population of the Mackenzie			4214

Athabasca.

Forts Chipewyan and Smith, 1879.....	Chipewyans	537	
Fond du Lac, 1879	Crees	86	623
	Caribou-eaters		318
Vermilion (Peace river), 1879.....	Beavers	234	
	Crees	6	240
Fort MacMurray (Athabasca river), 1879.....	Chipewyans	31	
	Crees	22	53
Fort Dunnegan (Peace river), 1879.....	Beavers & Sécanais	195	
Fort St. John (Peace R.), 1879. Lesser Slave L..	Crees	137	332
	Sécanais		195
Population of Athabasca			1761
Maximum total			5975

MICROSCOPY AND HISTOLOGY.[1]

SECTIONS OF DIATOMS.—Dr. J. H. L. Flögel's paper on "Researches on the structure of cell-walls of Diatoms" was brought before the meeting by Mr. J. Mayall, Jr., who, in his preliminary remarks, said that it would be remembered that some time ago they had heard reports that some one abroad was making sections of diatoms, and he was requested by Mr. Crisp to institute inquiries with the view of bringing the method before the society. He subsequently found that this work was being done by Dr. Flögel, of Holstein, who, there appeared no reason to doubt, was not only a skilled and competent observer, but that he possessed every kind of appliance for making careful observations. Having ascertained this, the next thing was to obtain specimens of actual sections of diatoms, without which it was of course not possible to form any satisfactory judgment on the matter. He was fortunate in persuading Dr. Schröder, now resident in London, to write to Dr. Flögel upon the subject, and in the result they had received a very elaborate paper accompanied by a dozen slides and a number of photographs and drawings in illustration.

A careful examination of the slides showed that Dr. Flögel was thoroughly familiar with the finest processes of mounting, and with all that had been done by Möller. One of the slides

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

was exhibited in the room under a $\frac{1}{25}$ in. objective by Mr. Powell. It was a section of *Triceratium favus*, and the excellence of the specimen gave rise to the impression that something even more difficult than this could be accomplished. Amongst the other specimens sent were some very clean-cut sections giving an exceptionally clear image. It was stated by Dr. Flögel that as many as 174 transverse sections had been made of one diatom., all of which could be plainly identified as belonging to the same diatom. Mr. Mayall said that he could not pledge himself as to the correctness or otherwise of the theory set up by the author of the paper, as the subject was not one which he had made his own, although he had taken some pains to translate the paper for publication in the journal of the society.

Mr. Mayall then read an abstract of the paper to the meeting, and the subject was discussed by Mr. Curties, Mr. Crisp and other fellows.

The chairman in proposing a vote of thanks to Mr. Flögel for his paper, said that he was sure the society would feel doubly indebted to Mr. Mayall for the exertions which he had made to procure the paper, and also for the trouble he had taken in the matter of translation.

Mr. W. J. Sollas's letter on the subject of cutting sections of diatoms was formally laid before the meeting. It had reference to the paper of Dr. Flögel, read at the December meeting, and was also intended to be read at that meeting, but did not come to hand until the meeting was over, when it was informally communicated to those present. The letter was as follows:

"For some time past I have been engaged in cutting sections of diatoms. My plan is to scrape off a green slime from our river mud, consisting chiefly of *Pleurosigma zigzag*, a large species suitable for cutting. The slime, together with some mud unavoidably gathered at the same time, is placed in a saucer and covered with a piece of muslin, which lies in immediate contact with the mud, while a film of water lies above it. The saucer is now exposed to daylight and the diatoms creep through the muslin, collecting in a consistent film on its upper surface. The muslin may now be lifted from the mud; it comes away clean, bringing all the diatoms with it, but leaving the mud. The muslin with the diatom film is now immersed in the usual hardening and staining reagents. I have used a mixture of chromic and osmic acids and absolute alcohol for hardening; borax-carmine, hæmatoxylin and eosin for staining. When duly stained and hardened the diatom films may be removed from the muslin without difficulty and cut either by imbedding in pure paraffine (melting point 58°) and mounting in Canada balsam, or by freezing in gelatine jelly, which allows one to cut *consistent sections which may be mounted direct in glycerine* on a glass slide without passing through water. By employing these two processes I have made

out the internal structure of diatoms, and believe that I can detect fine protoplasmic threads proceeding from the protoplasm that surrounds the nucleus and passing through apertures in the median keel. I am not yet, however, in a position to demonstrate this with absolute certainty, but hope to do so soon."—*Jour. of the Roy. Micros. Soc., Feb., 1884.*

Killing Hydroid Zoophytes and Polyzoa with the Tentacles extended.—H. C. Chadwick recommends the polyzoön to be placed in a small beaker or clear glass bottle, and allowed to remain at rest for several hours. Now take a dipping-tube, drawn out to a very fine point, and charge it with absolute alcohol. Having ascertained by means of a pocket-lens that the polypides are fully extended, allow the alcohol to drop very gently from the point of the tube which should be held just above the surface of the water. The success of the experiment depends largely upon the care with which the first quantity of alcohol is introduced into the water. After the lapse of an hour, if the polypides are still extended, a further quantity of alcohol is added until the quantity reaches sixty per cent.

After passing through seventy-five per cent alcohol, the specimens may be kept in ninety per cent of the same until required for mounting. Experiments with alcohol upon hydroid zoöphytes were not so successful, but Kleinenberg's picrosulphuric acid solution gave excellent results. The use of this reagent is attended with much less difficulty than that of alcohol. If the subject of the experiment is a zoöphyte, such as *Aglaophenia pluma* or *Plumularia setacea*, it must be allowed to remain some hours until the polypides are fully extended. Kleinenberg's fluid must then be introduced by means of a dipping-tube. It may be allowed to flow over the specimen in a continuous stream until the whole of the water assumes a golden-yellow color. The reagent causes instant death, so that the specimens may be transferred immediately to sixty per cent, and afterwards to seventy-five per cent alcohol, allowing them to remain in each solution for some hours. Keep in ninety per cent alcohol. From four to six minutes' immersion in Martindale's picrocarmine staining fluid is sufficient to stain specimens killed by either of the above methods.—*Jour. of the Roy. Micros. Soc., Feb., 1884.*

Mounting Fluid for Algæ.—For preserving the cell-contents and the natural color and form of desmids, volvox and other algæ, G. W. Morehouse finds a mounting fluid made as follows to act well: Dissolve fifteen grains of acetate of copper in a mixture of four fluid ounces of camphor water, four fluid ounces of distilled water and twenty minims of glacial acetic acid; add eight fluid ounces of Price's glycerine, and filter. When sections of plant-stems or other vegetable specimens are mounted in this fluid, the protoplasm is preserved. If in any case it is thought desi-

rable to increase or diminish the specific gravity of the preservative, the proportion of glycerine may be changed. Used as above, or modified as indicated, he thinks it also a trustworthy medium for mounting Infusoria and the softer animal tissues.—*Jour. of the Roy. Micros. Soc., Feb., 1884.*

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SCIENTIFIC NEWS.

— The thirty-third meeting of the American Association for the Advancement of Science will be held at Philadelphia, Penna., Sept. 4–10, 1884.

The British Association has invited the members of the American Association to join in the meeting at Montreal, and the American Association and the local committee of Philadelphia have invited the members of the British Association, with their near relatives who may be with them, to take part in the Philadelphia meeting.

A series of receptions will be offered the association and its guests, including one at the Academy of Music after the president's address; a reception at the Academy of the Fine Arts; a garden party at Haverford College, and a microscopical exhibition at the Academy of Natural Sciences. The botanical section of the Academy of Natural Sciences will organize botanical excursions, and will also hold a special meeting at the Academy for Botanists. There will be visits to the Internatianal Electrical Exhibition, the Zoölogical Gardens, Fairmount Park, Independence Hall and other places of interest, and the various institutions in the city will welcome the association to their halls. Several excursions will be offered to take place during the session, to the sea-shore, the coal regions and other points of interest, and possibly limited excursions to more distant points after the meeting.

The meeting will be called to order, in general session, at 10 o'clock on Thursday morning, Sept. 4th, in the Academy of Music, by President C. A. Young, of Princeton, who will resign the chair to the president-elect, Professor J. P. Lesley, of Philadelphia. After the adjournment of the general session, the sections will organize in their respective halls. General sessions and sections will be held on Friday. The vice-presidents of the sections will probably give their addresses during the day, and in the evening President Young will deliver his address at the Academy of Music, after which there will be a reception tendered to the members of the association, and their invited guests, by the local committee and citizens of Philadelphia. Saturday will probably be given up to excursions and receptions. The general programme for the rest of the meeting will be similar to that at previous meetings.

The headquarters of the association will be at the Academy of

Music, which is on Broad street, near the station of the Pennsylvania railroad and several large hotels. The sections will be amply accommodated in other halls in the immediate vicinity.

The offices of the permanent secretary and local committee, the association post-office, etc., will be at the Academy of Music after Sept. 1st; previous to that they will be at the Academy of Natural Sciences. The permanent secretary will establish his office in Philadelphia on August 22.

All matters relating to membership, the presentation of papers and business to come before the association, will be attended to by the *permanent secretary* at his office in *Salem, Mass., up to August 20.* After this date and until the meeting has adjourned, the address of the permanent secretary will be HOTEL LAFAYTTE, Philadelphia, Pa.

— Prizes given by the French Academy.—The "Prix Francœur" for discoveries in real or applied mathematics, was unanimously awarded to M. Emile Barbier, the laureate of 1882.

The prize of 6000 francs for studies calculated to increase the efficiency of the navy, was divided between M. Taurines, to whom 3000 francs was allotted for his forthcoming work entitled "Steam engines: a historical and critical account of the dynamometric results of the working of marine engines," M. Germain, to whom 2000 francs was given for his "Theoretical and practical treatise upon Hydrography," and M. A. de Magnac, who received 1000 francs for a work entitled "New Astronomical Navigation," published in 1877, and the result of the joint labor of M. de Magnac and the deceased M. Yvon de Villarceau.

The "Prix Poncelet" was given to M. G. H. Halphen; the Montyon prize was parted between M. Leon Francq for perfecting Lamm's steam-engine, and M. L. Renouf for a mathematical instrument designed to simplify the taking of levels at sea; and the Plumey prize was given to the lieutenant of the *Jacquemier* for the invention of the "cinemometer," which effects transmission of movement by means of rachet-wheels and levers.

In astronomy the "Prix Lalande" was awarded to MM. Bonquet de la Gyre, de Bernardieres, Courcelle-Senevil, Fleuriais, Hatt, Perrotin, Bassot, Bigourdain and Callandreau, the members of the French expedition to observe the transit of Venus in 1882; while the "Prix Valz" was given to M. Stephan, the director of the Marseilles observatory, a savant whose discovery of seven hundred nebulæ does honor to French astronomy.

The "Prix Lacaze" (physics) was awarded to M. Henri Becquerel, engineer of roads and bridges, for the total of his works upon experimental physics.

The "Prix Montyon" (statistics) was allotted to the deceased M. Ch. Nicholas, author of the important work, "The Budgets of France since the commencement of the XIX century." This

work is complete, of exceptional merit, and indispensable to political economists, statesmen and financiers.

In chemistry the Jecker prize was given to M. Etard for his numerous and important discoveries in organic chemistry, among which may be cited his experiments upon the action of chloro-chromic acid on organic substances, his researches on strychnine, on the ptomaines and on nicotine.

The "Prix Lacaze" was awarded to M. L. Cailletet for his investigations into the liquefaction of gases. He was the first to show the possibility of liquefying what are called the permanent gases, and science owes also to him a simple apparatus with which these experiments can be carried on without danger. *To be continued.*

— The French Society for the Advancement of Science, which will meet at Blois in September (4–11), has before it the duty of distributing a sum of about £800, being the first five years' accumulation of the legacy left to it in 1878, by M. Girard, to enable it to give rewards once in every five years to the person or persons who have most contributed to advance science upon the question of the antiquity of man with regard to geological formations.

— The number of applications for tickets for the British Association meeting this year is 772, and the council have resolved not to receive any more prior to the meeting at Montreal, when members and associates will be elected as usual.

— The Council of the British Association have resolved to receive the standing committee and fellows of the American Association on the footing of honorary members at the Montreal meeting.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, May 3.—Communications were made by Dr. R. W. Shufeldt, U.S.A., on the occurrence of a pair of free ribs on the occipital bone of the large-mouthed black bass, *Micropterus salmoides;* by Mr. N. P. Scudder, observations upon the muskrat, *Fiber zibethicus;* and by Dr. Theodore Gill on the system of the Squali.

Boston Society of Natural History.—The annual meeting was held on May 7, 1884. Annual reports were made by the curator, secretary and treasurer, followed by the election of officers for 1884–5, and of candidates for membership. The third award of the grand Walker prize was announced, and the committee on the annual Walker prize made its report, awarding it to Dr. Tuttle for his essay on the anatomy and embryology of *Lunatia heros.* Mr. F. W. Putnam spoke of some interesting recent discoveries relating to the antiquity of man in America, in

the Trenton gravels and in Nicaragua, and also gave evidence of the practice of cremation by an ancient people in the Little Miami valley. Dr. M. E. Wadsworth read a paper on the origin of ore deposits.

The last general meeting was held on May 21. Mr. S. Garman spoke of certain works of the Indians, and Professor A. Hyatt discussed the affinities of Beatricea.

New York Academy of Sciences, May 12.—The following papers were announced: The colored marbles of Lake Champlain (illustrated with a suite of specimens), by Mr. Arthur H. Elliott; a remarkable Chlorophane from Amelia county, Virginia, by Mr. George F. Kunz.

May 26.—The following papers were announced: Bees and other hoarding insects: their specialization into males, females and workers, by Mr. E. A. Curley; The origin of Puget sound and its connected system of tideways, by Professor John S. Newberry.

Appalachian Mountain Club, May 14.—The following paper was presented: A photographic study of the Matterhorn, by Professor Edward C. Pickering.

American Philosophical Society, Jan. 18.—Professor Cope exhibited fossils of the family Oreodontidæ, and described their characteristic structure and geological relations. A drawing of a sarcophagus in Memorial Hall, with a translation of the legend on the cover, by Commodore McCauley, were exhibited. Dr. Frazer communicated a table of barometric levels taken by him recently in Texas and New Mexico, and described the geological structure of the neighborhood. Professor Cope remarked that the formation which forms the banks of the Rio Grande at Laredo, Texas, is in all probability the Laramie. It contains at that point a thick bed of pure lignite. Above Laredo, on both sides of the river, an excellent lignite is mined. The wide valley of the Rio Grande as far as the eastern ranges of the Sierra Madre is probably of Laramic age, as Dr. C. A. White reports fossil mollusca of that age from near Lampazas, at the foot of the mountains. Mr. Arthur Schott (U. S. Mex. Bound. Survey I, Geology, p. 35), first observed these lignites, and Mr. Conrad pointed out the existence of Claiborne Eocene beds in the same region (loc. cit., p. 141). Professor Cope stated that the Claiborne beds rested immediately on the Laramie at Laredo.

Feb. 1.—Professor Cope exhibited specimens of Creodonta, and sketched the classification of that order.

Feb. 15.—Sections of the anthracite coal measures, recently executed by the Geological Survey of the State, were exhibited.

Dr. Frazer exhibited copies of hieroglyphs found in the Puerto San Antonio, Coahuila, Mexico, not previously described, and also spoke of his discovery of a sacrificial stone of great weight and

age, lying sixty or seventy miles distant from any similar rock, and in a mountain pass famous in history. Size five to six by three to four feet high. The edges are full of sharp serrations, and the weight must be at least five and one-half tons. The stone has a notch by which the blood flowed off.

March 7.—Professor Cope read a paper entitled "On the Structure of the Skull in the Elasmobranch genus Didymodus."

Mr. Ashburner presented some notes "On the aneroid hypsometry," and exhibited a self-registering field instrument.

March 21.—A communication from Professor Claypole, entitled "On the Clinton and other shales composing the Fifth Group of Rogers in the first survey of Pennsylvania," was read.

April 4.—Professor Lesley read from a letter of J. F. Carll, a correction of the horizon of *Eurypterus pennsylvanicus*, described by Mr. C. E. Hall. The fossil was found seventy-two feet above the mouth of the Pithole well, *i. e.*, 167 feet above the Berea or Pithole grit.

Mr. Blasius read a paper on the unhealthy condition of certain portions of great cities, owing to prevalent winds, and spoke of the necessity of rapid transit.

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND, May 10.—In the absence of the president, Dr. Britton was elected chairman *pro tem.* Three new members were elected and other business transacted, after which Mr. Hollick read a paper upon "Recent discoveries of Indian Implements at Tottenville." The following is a complete list of the different objects thus far found: one axe, one pipe, five hammer stones, ten arrow-heads, thirty-seven net sinkers, seven miscellaneous and innumerable chips and fragments. It is but little more than a year since the first of these was accidentally discovered while on a field excursion to the locality. Since then, whenever the place has been visited and searched, relics have invariably been found. Mr. George F. Kunz, of New York, who was present by invitation, then presented the stone head found near Clifton, and gave the following account of the same: As now preserved it shows the material of which it was formed to be a brown sandstone, apparently more compact than the common New Jersey sandstone, and composed almost entirely of grains of quartz with an occasional small pebble, one of these, measuring one-fifth of an inch across, is on the bridge of the nose, and another, a little smaller, in the center of the forehead. The features are too well cut for a common off-hand piece of work by a stonemaker; the style is not Egyptian or Eastern; rendering it unlikely that it is a part of an antiquity thrown away by some sailor; it is rather Mexican, and still more resembles Aztec work. This leads to the inference that it is probably of Indian origin, or if not, it is remotely possible that it was made by the early Dutch.

THE

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THE GLACIATED AREA OF NORTH AMERICA.

BY REV. G. FREDERICK WRIGHT.

I AM asked to give, for the convenience of the readers of the NATURALIST, a brief summary of the present results of my glacial investigations during the past ten years. This I am enabled to do more concisely because of the plates which I am permitted by my publisher to use so freely.[1]

The special marks characteristic of the glaciated region consist of striated rocks, striated pebbles, transported boulders and an unstratified deposit called "till." These are now too familiar to need description. My investigations have chiefly had in view the determination and study of the southern boundary of the glaciated area in Eastern United States. I have zigzagged the whole boundary from the Atlantic ocean to the State of Illinois, the results being given in the accompanying plates, the correctness of which the reader may readily verify for himself, for when one has become once familiar with the glacial signs indicated above, he cannot fail to notice their conspicuous absence south of the boundary line indicated.

It will be observed that in New England the rivers reach the sea inside the glacial limit, and they are all characterized throughout their whole extent by terraces of coarse gravel, varying

[1] For fuller details of my work see Proceedings of the Boston Society of Natural History, Vol. XIX, pp. 47–63, Vol. XX, pp. 210–220, Vol. XXI, pp. 137–145; Geological Report of New Hampshire, Vol. III, pp. 167–170; *American Journal of Science*, Vol. CXXI, pp. 120–123, Vol. CXXVI, pp. 44–56; AMERICAN NATURALIST, Vol. XVIII, pp. 563–567; but especially my "Studies in Science and Religion": Andover: W. F. Draper. 1882, pp. 256–350, and the "Glacial Boundary in Ohio, Indiana and Kentucky": Cleveland: Western Reserve Historical Society. 1884, pp. 86; Ohio Geological Report, Vol. V, pp. 750–771.

in height from a few feet to one hundred or more feet above the present flood-plain. These are now shown to have been deposited during the last stages of the glacial period by the "immense spring freshets" which marked the melting away of the vast body of ice. Many of these gravel deposits, however, are unconnected with present water-courses, but run across the country for scores of miles in long, tortuous systems of gravel ridges from a few feet to one hundred feet above the valleys in which they are situated. These are now called "kames," and correspond to "åsars" in Sweden, and were evidently formed contemporaneously with the terraces.

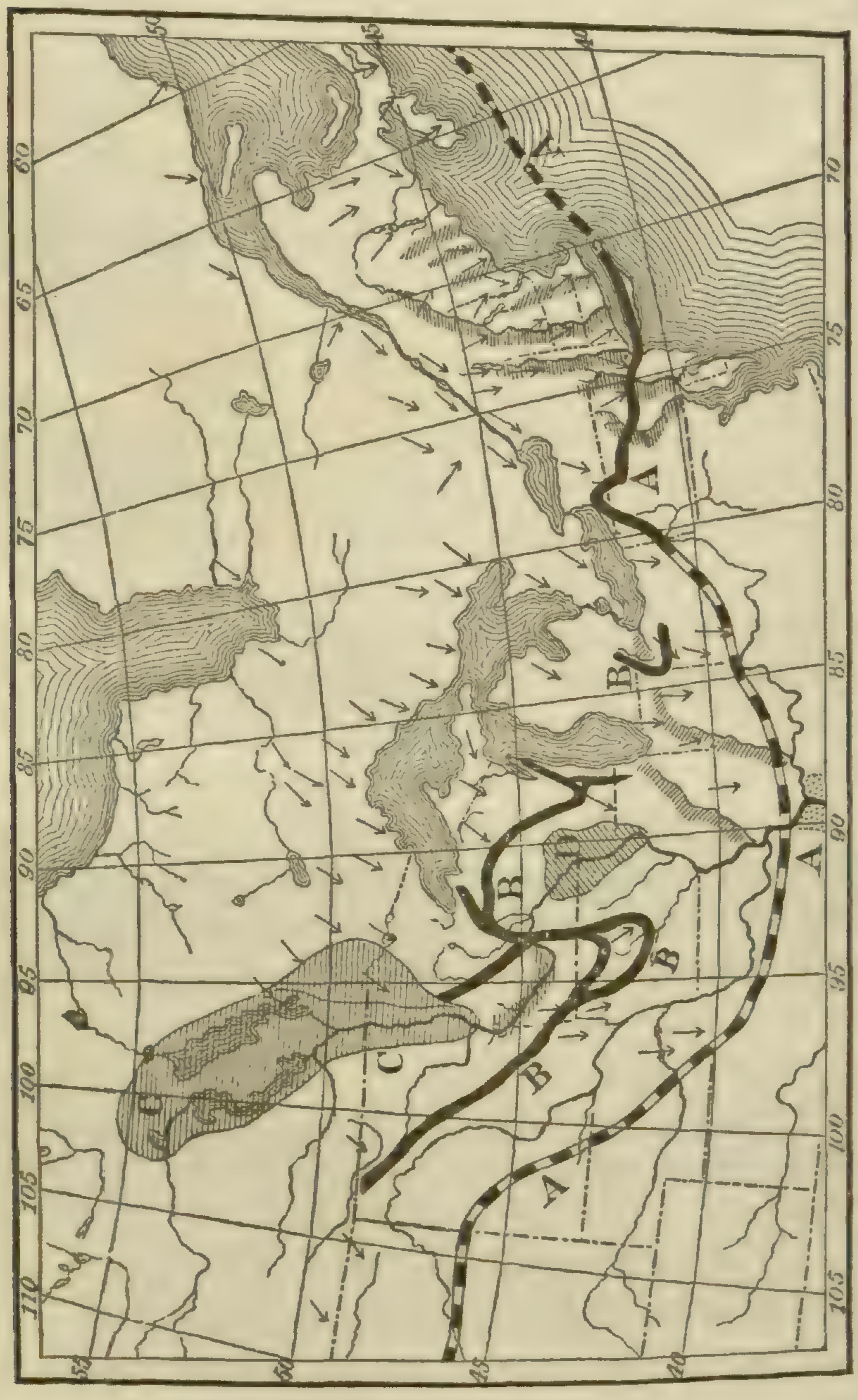

FIG. 1 (taken from the author's "Studies in Science and Religion") shows a portion of the glaciated area of North America. AA represents the boundary of the glaciated area. The continuous line is from actual survey in 1881. (For completion to Illinois see Figures 4 and 10. The broken part is still somewhat conjectural.) BB marks special glacial accumulations. CC represents Lake Agassiz, a temporary body of water formed by the damming up by ice of the streams flowing into Hudson's bay, the outlet being, meanwhile, through the Minnesota. D is a driftless region which ice surrounded without covering. The arrows indicate the direction of glacial scratches. The lines of New England and the terraces upon the Western rivers are imperfectly shown upon so small a map

West of New Jersey streams are continually encountered whose sources are in the glaciated area, and whose mouths are in the unglaciated. Fig. 2 illustrates this in the case of the Delaware, which is of special interest because the glacial terraces

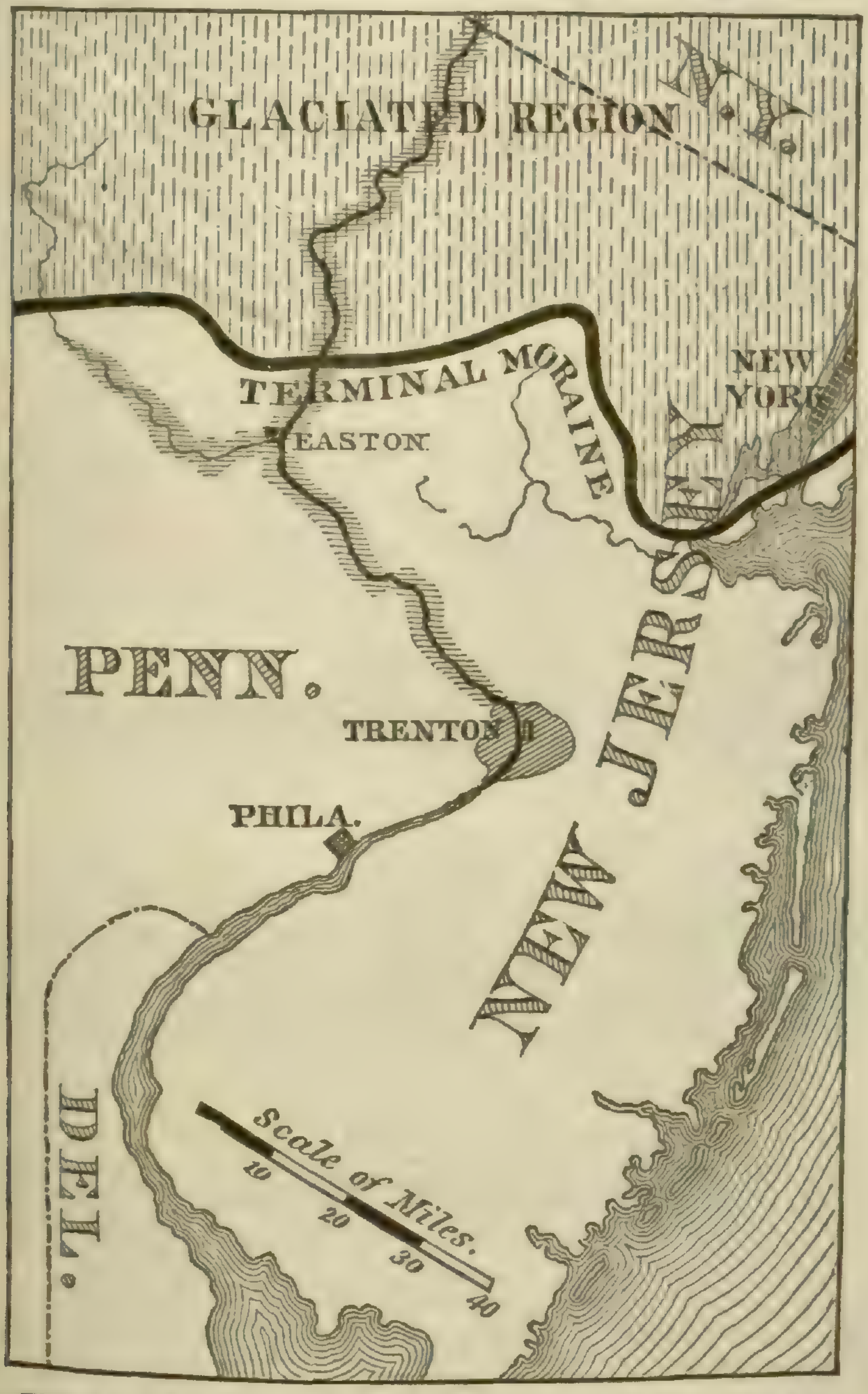

FIG. 2.—This cut (taken from "Studies in Science and Religion") shows, in addition to the glaciated area of New Jersey, the glacial terraces of gravel along the Lehigh and Delaware rivers, and also the "Delta terrace" at Trenton, fifty feet above the river, in which Dr. C. C. Abbott has found palæolithic implements.

can be traced continuously down the river from the boundary line to a "delta terrace" of large extent at Trenton, whose surface is fifty feet above the present flood-plain. It is in this glacial terrace that Dr. C. C. Abbott has found so many palæolithic im-

plements.[1] Professor Cook has also found in these same glacial gravels the tusk of a mastodon. In riding from New York to Philadelphia on the New Jersey Central railroad, the train passes

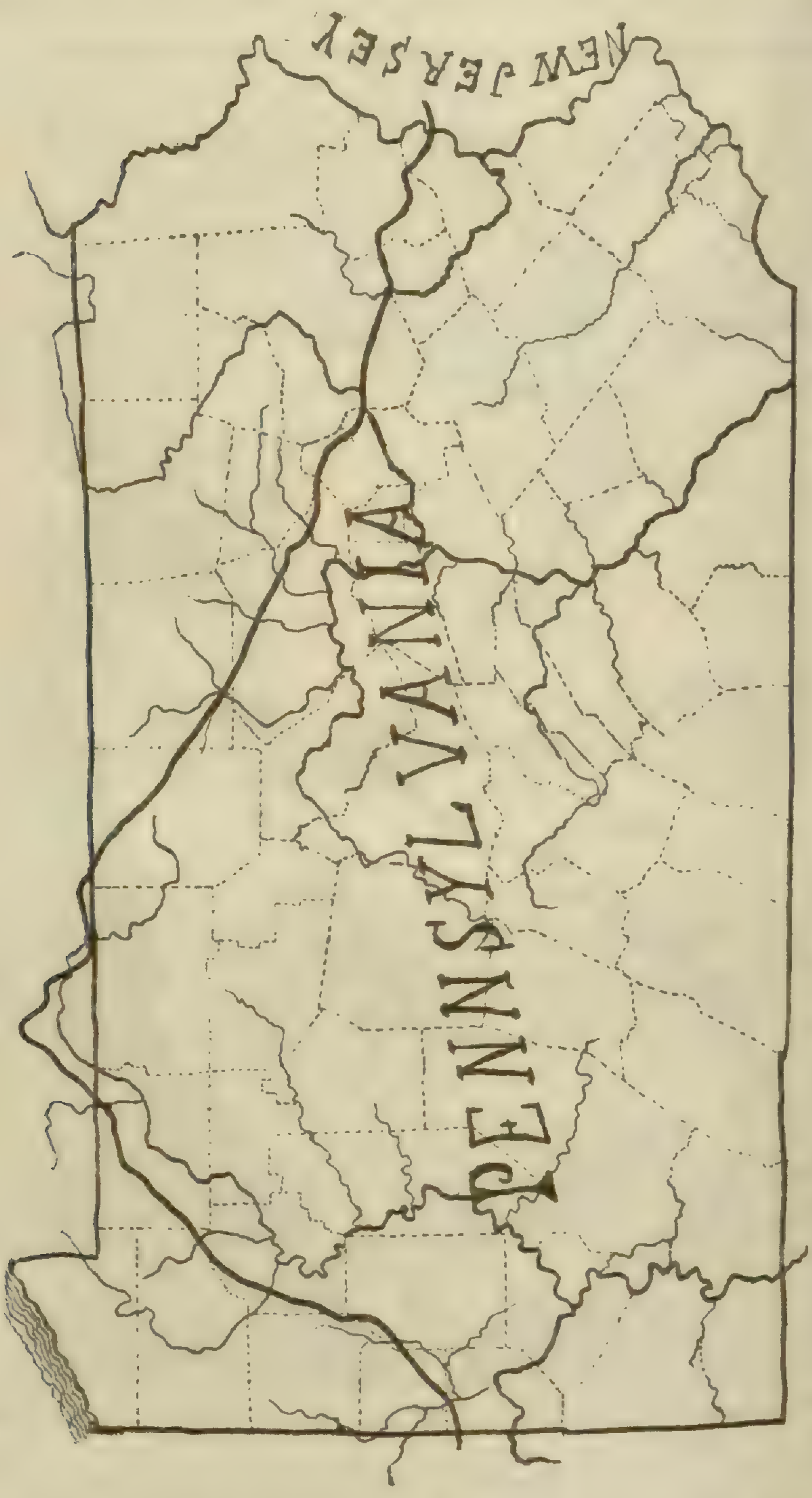

FIG. 3.—The broad, black line shows southern boundary of glaciated area of Pennsylvania. This and the remaining figures are from the "Glacial Boundary in Ohio, Indiana and Kentucky," published by the Cleveland Historical Society.

from the glaciated to the unglaciated region at Metuchen, and on the Bound Brook route at Plainfield, and in both cases the boundary line is marked by extensive accumulations of gla-

[1] See his "Primitive Industry," Salem, Mass., 1881.

ciated material rising in hills from thirty to seventy feet in height.[1]

Fig. 3 shows the boundary line across Pennsylvania with a remarkable bend to the north as it crosses the Appalachian mountains, passing through Northampton, Monroe, Luzerne, Columbia, Lycoming, Tioga and Potter counties, thence through Allegheny and Cattaraugus counties in New York, thence back again in Pennsylvania through Warren, Venango, Mercer and Lawrence counties.[2]

FIG. 4.—Map showing southern boundary of glaciated area of Ohio.

In Fig. 4 the dotted portion shows the glaciated area of Ohio.

[1] For details respecting the boundary in New Jersey, see the report of Professors Cook and Smock for 1878, 1879, 1880.

[2] For details see the joint report of Professor H. Carvill Lewis and myself, soon to be issued by Professor Lesley as a part of the State geological report.

The accompanying list of counties is numbered to correspond to those in the plate:

1. Williams.	23. Hardin.	45. Pike.	67. Muskingum.
2. Defiance.	24. Logan.	46. Adams.	68. Morgan.
3. Paulding.	25. Champaign.	47. Sciota.	69. Athens.
4. Van Wert.	26. Clarke.	48. Erie.	70. Meigs.
5. Mercer.	27. Greene.	49. Huron.	71. Gallia.
6. Darke.	28. Clinton.	50. Lorain.	72. Lake.
7. Preble.	29. Brown.	51. Richland.	73. Geauga.
8. Butler.	30. Ottawa.	52. Ashland.	74. Portage.
9. Hamilton.	31. Sandusky.	53. Knox.	75. Stark.
10. Fulton.	32. Seneca.	54. Licking.	76. Tuscarawas.
11. Henry.	33. Wyandot.	55. Fairfield.	77. Guernsey.
12. Putnam.	34. Crawford.	56. Perry.	78. Noble.
13. Allen.	35. Marion.	57. Hocking.	79. Ashtabula.
14. Auglaize.	36. Morrow.	58. Vinton.	80. Trumbull.
15. Shelby.	37. Union.	59. Jackson.	81. Mahoning
16. Miami.	38. Delaware.	60. Lawrence.	82. Columbiana.
17. Montgomery.	39. Madison.	61. Cuyahoga.	83. Carroll.
18. Warren.	40. Franklin.	62. Medina.	84. Harrison.
19. Clermont.	41. Fayette.	63. Summit.	85. Jefferson.
20. Lucas.	42. Pickaway.	64. Wayne.	86. Belmont.
21. Wood.	43. Ross.	65. Holmes.	87. Monroe.
22. Hancock.	44. Highland.	66. Coshocton.	88. Washington.

The five figures numbered 5, 6, 7, 8, 9, give the section that I have zigzagged through Ohio on the scale of six miles to the inch. Upon the first two plates I endeavored to represent the boundary of what Professor Lewis and myself called the "fringe": the broad dark line representing the limit of the more considerable glacial deposits, the broken line the extreme limit of glacial boulders out of reach of the water courses. West of Stark county I did not think it best to draw this distinction, and my line marks the extreme limit of true glacial action. It will be interesting and important for other investigators to examine the fringe throughout the whole line, and inquire why in some places it is so broad and in other places there is none at all. Glacial deposits of special amount are found at the following places at or near the margin in Ohio: Columbiana county—Palestine, the northern part of Centre township, and New Alexandria; Stark county—two miles south-west of Canton, north of Wilmot; Holmes county—a little north of the line throughout; Knox county—Danville, Millwood, Bladensburg; Licking county—Wilkin's run, Newark, Amsterdam; Perry county—Thornville; Fairfield county—Rushville, the vicinity of Bern station, Lan-

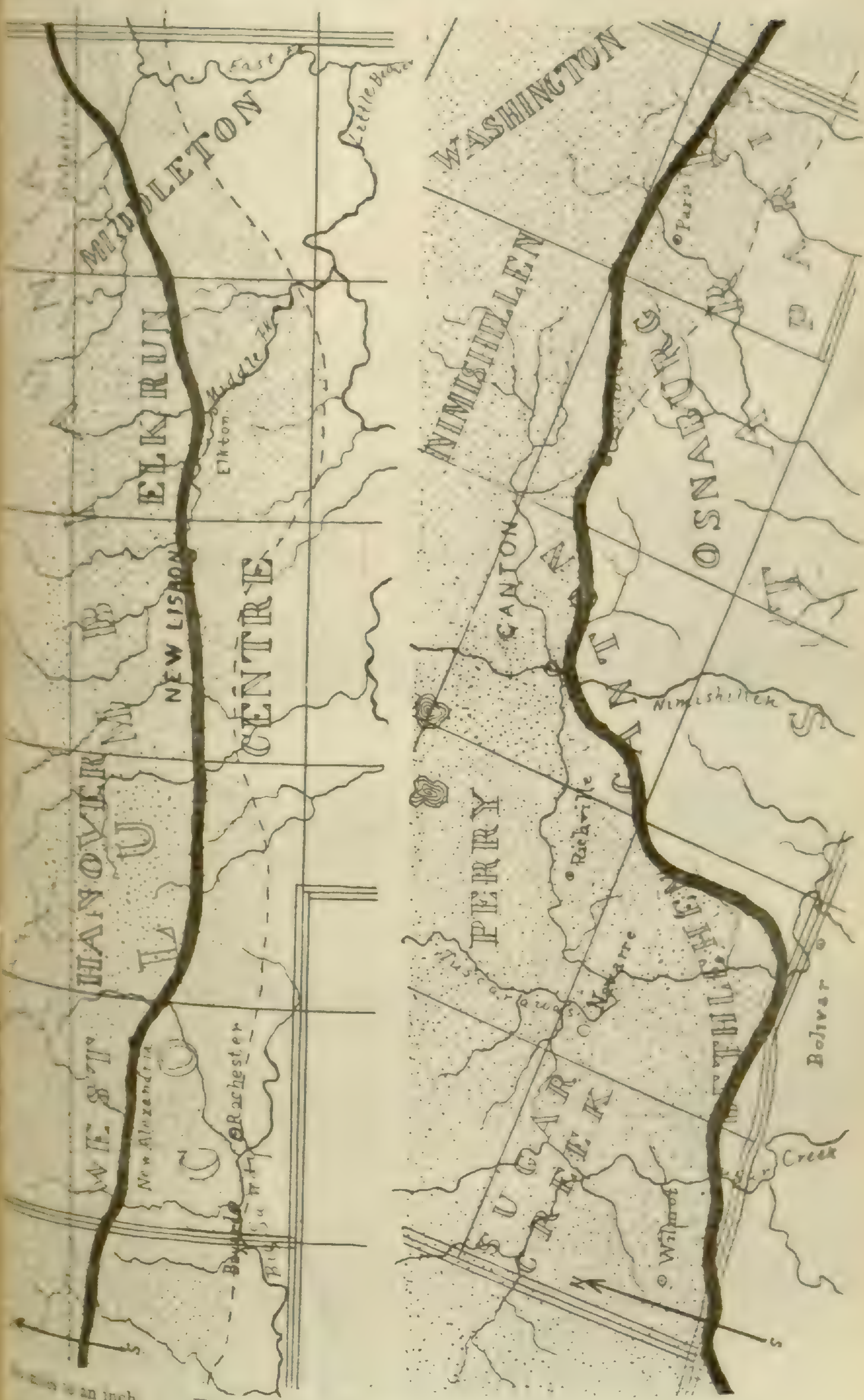

FIG. 5.—Glacial Limits in Ohio.

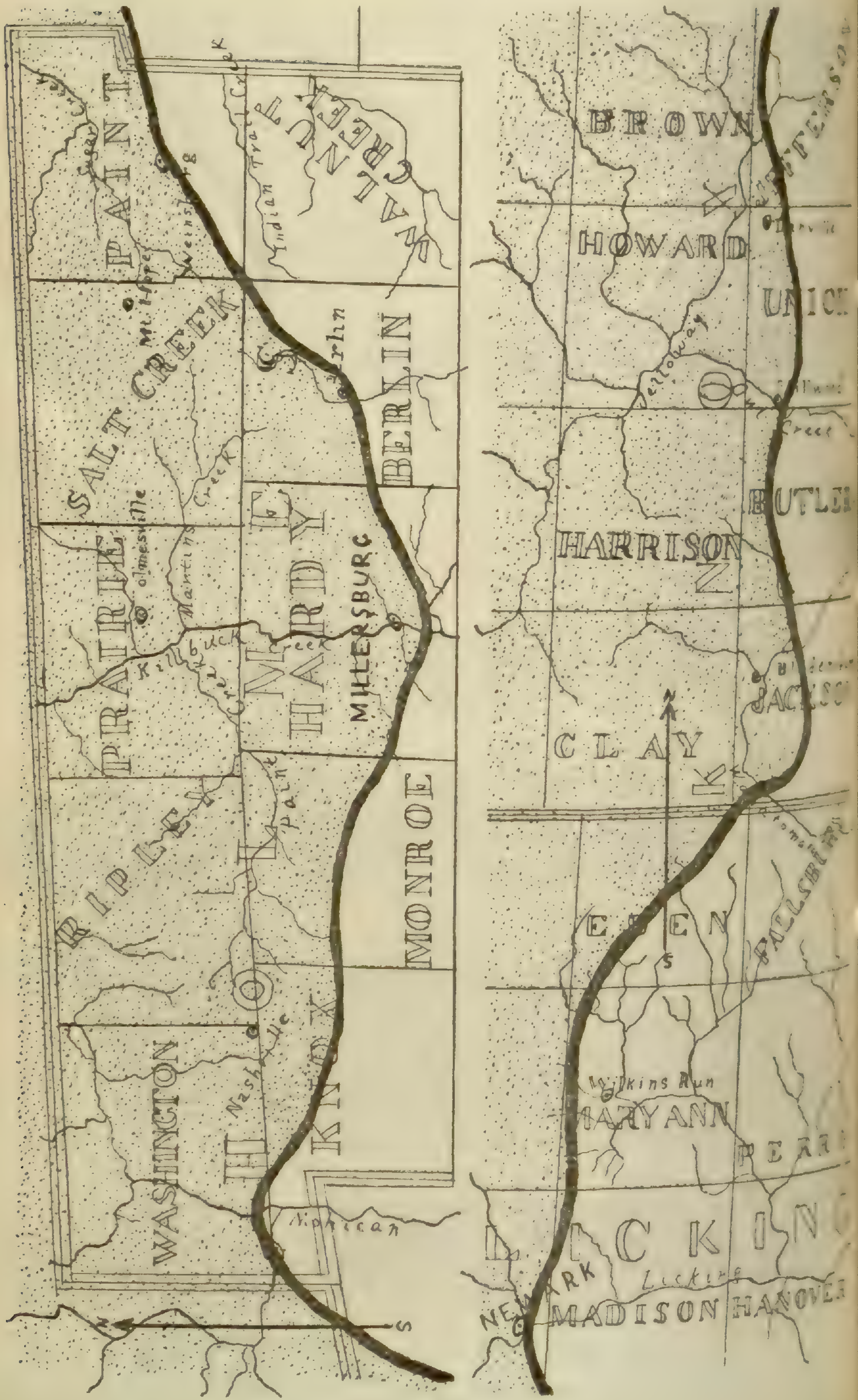

FIG. 6.—Glacial Limits in Ohio.

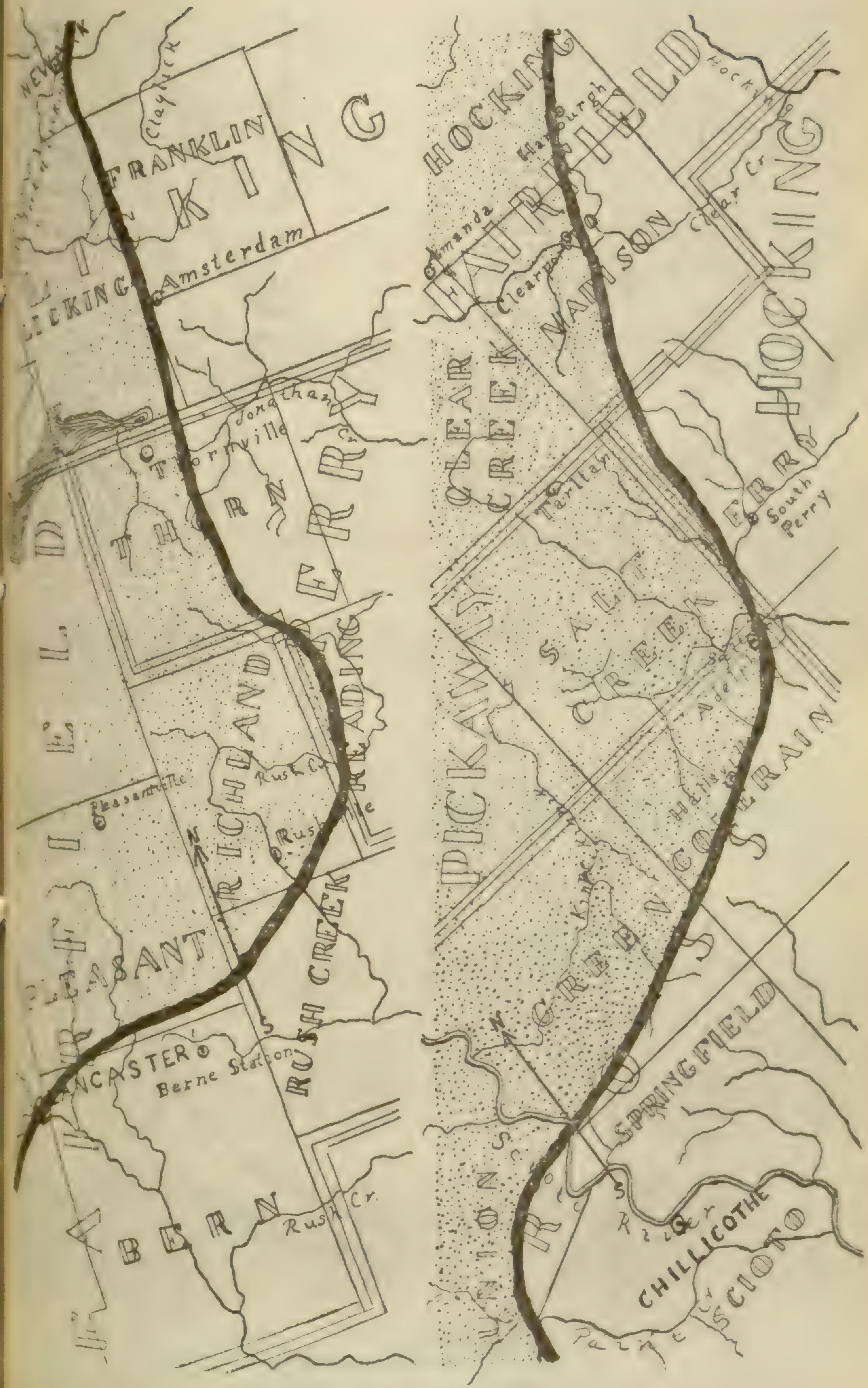

FIG. 7.—Glacial Limits in Ohio.

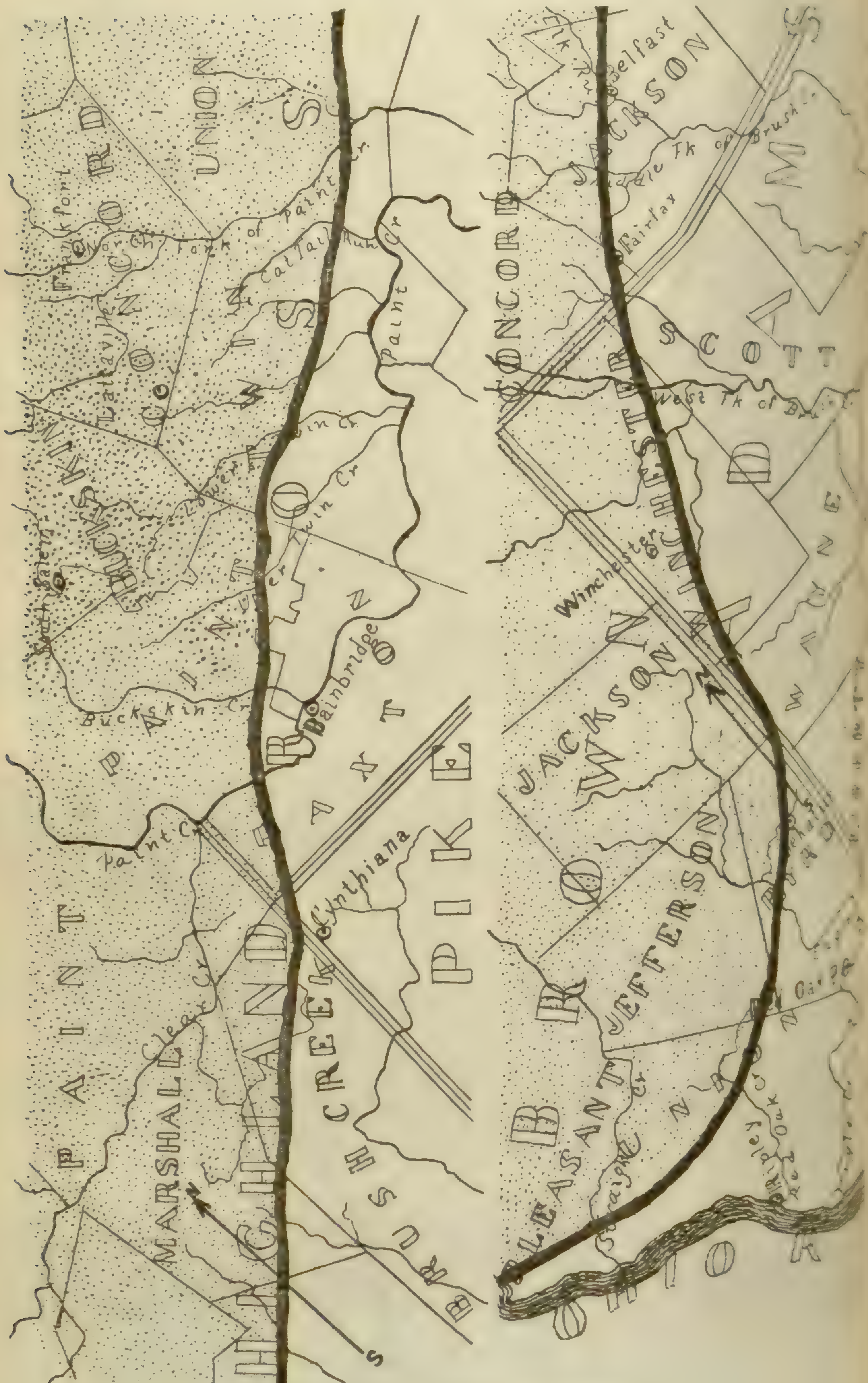

FIG. 8.—Glacial Limits in Ohio.

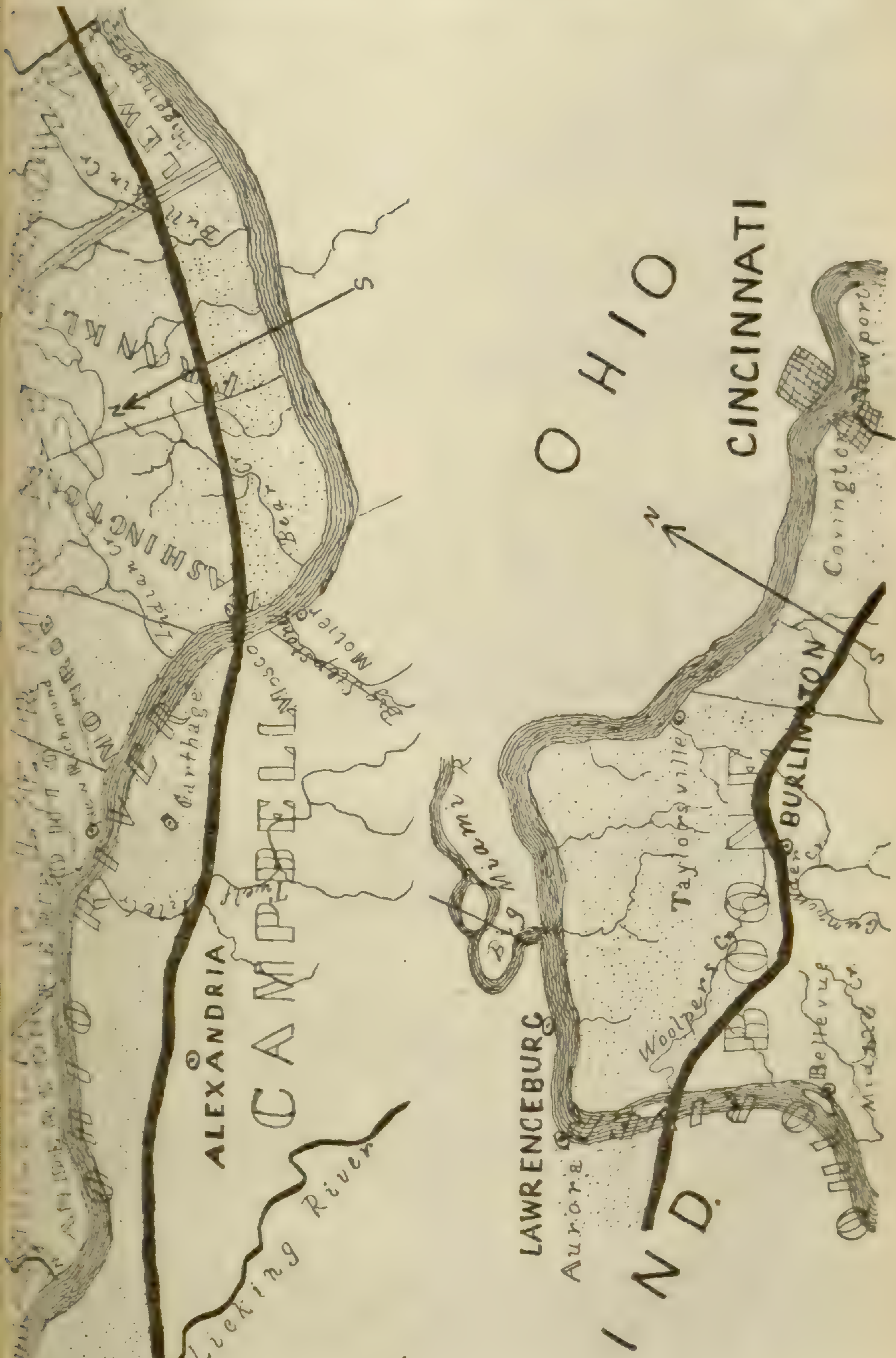
OHIO
CINCINNATI
COLUMBUS
ZANESVILLE
CAMBRIDGE
ALEXANDRIA
LAWRENCEBURG
INDIANA
Licking River
Muskingum River
Scioto River
Hocking River
Kanawha River
Ohio River
Great Miami River
Little Miami River
Mad River
Big Walnut Creek
Big Darby Creek
Big Pickaway Creek
Paint Creek
Rattlesnake Creek
Deer Creek
Salt Creek
Jonathan Creek
Wills Creek
Duck Creek
Meigs Creek
Leading Creek
Shade River
Raccoon Creek
Symmes Creek
Big Sandy River
Guyandotte River
Big Sandy Creek
Little Sandy Creek
Middle Island Creek
Little Kanawha River
Hocking Canal
Ohio Canal
Muskingum Canal
Miami Canal
Wabash and Erie Canal
Portsmouth
Ironton
Gallipolis
Pomeroy
Middleport
Point Pleasant
Parkersburg
Marietta
Belpre
Coalton
Jackson
Wellston
Athens
Nelsonville
Logan
Lancaster
Newark
Zanesville
Cambridge
Taylorsville
Woolpert's Cr.
Dayton
Springfield
Xenia
Urbana
Piqua
Troy
Hamilton
Middletown
Lebanon
Waynesville
Xenia
Yellow Springs
Bellevue
Milan
Norwalk
Wakeman
Huron
Sandusky
Fremont
Bellevue
Tiffin
Fostoria
Findlay
Bowling Green
Perrysburg
Toledo
Maumee
Defiance
Napoleon
Auglaize
Wapakoneta
Sidney
Piqua
Troy
Greenville
Eaton
Hamilton
Middletown
Lebanon
Waynesville
Xenia
Yellow Springs
Urbana
Springfield
Dayton
Woolpert's Cr.
Taylorsville
Wilmington
Lebanon
Xenia
Yellow Springs
Urbana
Springfield
Dayton
Troy
Piqua
Sidney
Wapakoneta
Auglaize
Defiance
Napoleon
Maumee
Toledo
Perrysburg
Bowling Green
Fostoria
Findlay
Tiffin
Fremont
Sandusky
Milan
Norwalk
Wakeman
Huron

FIG. 10.—Map of Southern Indiana, showing glacial boundary.

caster and Clearport; Pickaway county—Tarlton; Ross county—Adelphi, Hallsville and throughout Green, Union, Concord and Buckskin townships; Highland county—in Paint and Northern Marshall townships; Adams county—the vicinity of Winchester; Kentucky—in the vicinity of Carthage, Burlington and Woolpers creek.

Figure 10 shows more distinctly the relation of the glacial limit to the Ohio river at Cincinnati, producing the supposed ice dam discussed in a previous number of the NATURALIST (see Vol. XVIII, June, 1884, pp. 563–567), and the line across Indiana traced by me last summer. The northern part of Dearborn, the whole of Ripley, Decatur, Jennings and Bartholomew counties are deeply covered with true glacial drift, and the extreme limit is pretty easily ascertained, though the deposits in Jefferson, Clark and Scott counties are scanty as compared with the counties farther north. The highest point of the State is in Brown county, 1150 feet above the sea. The ice deposits do not reach to that point, but are very deep and extensive a few miles north over the southern part of Johnson county. In Owen county there are numerous striæ running 50° east of south, or nearly at right angles to the glacial limit. The glacial deposits in Southwestern Indiana are covered with "loess," which is doubtless a water deposit, and will, to the westward, probably greatly increase the difficulty of tracing the exact southern boundary of the glaciated area.

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ON THE EVIDENCE THAT THE EARTH'S INTERIOR IS SOLID.

BY DR. M. E. WADSWORTH.

(Continued from page 686, July number.)

Conclusions.—Starting with the common belief that the earth was once an intensely hot gaseous body, it follows that when cooled from a gaseous to a liquid state, convection would cause the intermingling of all the liquid portions only so long as the heat kept every part at the same density. As soon as an especial difference in density manifested itself (if it had not already done so in the gaseous state) the heavier materials would sink towards the interior and the lighter pass outward towards the exterior. So soon as these materials became viscous the inter-

change would be retarded. Now, when convection no longer caused the heterogeneous materials of the earth to mingle, the cooling rate would change from the comparatively rapid rate of convection-cooling to the very slow rate of cooling by the conduction of liquids.

It is to be remembered that to have convection in liquids at all there must be some external source which shall, at some point, continually supply an increment of heat, but for a cooling globe no such supply exists. These are facts that ought to be taken into account in all discussions relating to the age of the earth or sun.

It would seem, however, that Thomson's view of the age of the earth is based upon the supposition that the earth during its liquid state was homogeneous and cooled throughout by convection, and that later it became solid and likewise cooled by the ordinary conduction of a solid body.

The writer would hold, in contradistinction, that after the earliest stages the liquid earth cooled by conduction in a heterogeneous liquid, and after the superficial crust was formed, by conduction not only through a heterogeneous liquid, but also a heterogeneous and, at least in its exterior portion, a more or less discontinuous or fragmental solid. In this way it would seem as if biologists might gain a portion, if not all, the time desired, which is now denied them by the physicist.

In the same way, if the heavier gases tend to lie nearest the center in a hot gaseous body, the exceedingly slow rate of cooling on account of the poor conductivity of gases ought to be taken into account in all discussions relating to the age of any body formerly gaseous. Another factor would be the heat disengaged by the chemical unions necessary to form the mineral combinations, now existant on the earth, out of the once disassociated gases.

But to return; when the lighter surface material of the earth had cooled sufficiently, a crust would be formed which, owing either to its lighter state in its hot condition, or to its scoriaceous character and the viscidity of the material beneath, would not sink. It is to be remembered that on account of the passage of rocks through the softened or viscous state to the solid, that the viscous material immediately below the solid crust would be in nearly the same condition and temperature as the overlying crust

into which it would gradually pass. It is not probable that the crust would break up and begin to sink, because even if its surface grew cold it would always have this hot, solid base, lighter than the underlying viscous liquid, which, owing to the increasing specific gravity as the interior was approached, would probably be more dense than any of the overlying cold crust.

Even if the crust should become heavier, break up and begin to sink, this sinking would be very slow on account of the viscosity of the liquid and its constantly increasing density, while the heat imparted to the sinking crust would tend to bring it to about the same specific gravity as the liquid, as the sinking mass neared its melting point. But above and beyond all, it would soon reach a point at which the liquid, being of different composition, had a higher specific gravity than the crust, and no farther sinking could take place. We should thus expect to have formed on the earth's surface a crust which never would sink, or if it sank at all, would for only a comparatively short distance, giving rise at that point to a solid crust floating upon a denser heterogeneous liquid. While willing to admit that the crust when cold would be heavier than the liquid out of which it was formed, it is denied that the exterior would cool to such an extent as to be heavier until solidification had taken place to sufficient depth to render the contraction of the exterior portion of but little effect; that is the increased density of the liquid immediately beneath the hot lighter interior portion of the crust would more than counterbalance the increased density of the cold exterior portion of that crust.

Sir William Thomson's idea of a crust on solidification sinking to the center of the earth and building up a honey-combed mass, is only applicable to a homogeneous liquid globe of but slight viscosity, whose material contracts in passing from the liquid to the solid state.

In such a condition of the earth as the writer supposes, a gradual passage from the cooled surface crust towards the hotter interior portions of that crust, thence into the plastic and viscous condition, no opportunity would exist for the generally supposed shrinking away of the nucleus from the rigid crust, but the entire earth would contract as a whole, causing a linear shortening of the crust through compression. This would occasion a crushing together of this crust, causing it to be depressed in some

places and elevated in others. The depression of any portion of the crust into the viscous liquid beneath would cause the elevation of an equivalent weight of the liquid material; as in the case of ice, the depression of the ice on one side causes the heavier water to overflow unless it can escape in some other direction. The simple sinking of a portion of the crust on one side with its corresponding but less elevation on the other, with the attendant fissuring, affords all the dynamic agent needed to raise lavas to the top of the highest mountains ;[1] while if in any way the yielding to the lateral compression should be sudden, instead of gradual, owing to fracturing and slipping of the parts, an earthquake shock would result.

If the general views of the compression of the material in the interior of the earth are correct, then if from any cause the pressure were removed, the natural expansion of the material, if liquid, would cause it to rise to some extent in any vent or opening.

During the earlier times when the crust was thinner and the internal heat stronger, a greater variety and amount of materials raised as lavas through the fissures would be expected, and not improbably outflows of two different kinds might take place at the same time, as it would seem had taken place on Lake Superior.

The up thrust of the still liquid and yielding interior portions through the fissures in the overlying crust, and the subsequent solidification of the intruded material, would cause that crust to be tied through and through with the underlying mass.

Neither is it to be expected that the contraction would be equal in every portion, while the depression of the crust into the interior would give rise to unequal thicknesses of that crust, to which the liquid outflows would add. The great irregularity of the under surface of the crust, coupled with the gradual passage from the solid to the viscous liquid interior would conspire to prevent any of the supposed slipping of the crust over the interior, as many physicists have assumed would take place if the earth had a liquid interior.

If it is held that volcanic rocks are derived from the re-liquefaction of the original crust of the earth, would not the best theory be, in the light of what is now known of the behavior of

[1] Whitney, "Earthquakes, Volcanoes and Mountain-building," p. 90.

rocks on their solidification, that increased pressure, brought about by contraction of the crust in cooling or by sediments deposited on a sinking area, or by some other cause, produce a lowering of the fusing point, as in the case of ice, and thus enable the natural heat of the rocks themselves to cause their passage into the liquid state?

It has been claimed with apparent justice that the simple depression of any portion of the earth's crust into the still liquefied portion of its interior, would tend to cause the base of the depressed portion to re-liquefy through the greater heat to which it would be then subjected to, thus making the re-fusion the natural result of the earth's contraction.

It appears to the writer that so far as any evidence now exists regarding the earth's interior, it is allowable to assume its present liquid state. A state that in his judgment accords better with the facts of petrography than any other assumption that has been made.

It is true that if the materials of the earth's interior were solid, but could be liquefied by diminution or increase of pressure, this liquefaction would perhaps be consonant with what is now known of the internal structure of rocks, especially the partial dissolving of the olivine of basalts, the hornblende of the andesites, the quartz of the rhyolites, etc. One of the greatest difficulties in the way of this supposition is to understand why the same lava should produce different crystals when it was in the interior from those yielded on the exterior of the earth.

It is difficult to see how, if the earth is solid, that any relief from pressure could take place otherwise than from the crushing together of the overlying rocks, the tearing up of these from the underlying ones, and elevating them into the air; that is, the relief from pressure would come from an elevating instead of a sinking process. In truth it would seem that eruptions and mountain building or elevations arose rather from the sinking of large masses causing smaller ones adjacent to rise, or, as announced by Dana, the highest border is on the side of the greatest ocean.[1] It would seem that elevation followed subsidence, instead of subsidence following elevation. If this is the case, it is difficult to explain how subsidence could be brought about first in a *solid* globe.

[1] "Man. Geol.," 1880, p. 28.

We cannot imagine that matter so rigid as the earth's interior is claimed to be, could yield to the pressure of sediments, glaciers or lava flows, as has been advocated. This view is based chiefly on the fact that areas of thick detrital formations must have been areas of subsidence, hence, it is argued, the deposit itself has been the cause of the sinking. The reverse appears rather to be true, that only areas of extended subsidence can be areas of great deposition. May it not then be claimed that the subsidence was the cause of the deposition instead of the deposition being the cause of the subsidence; and is not the former view more natural than the latter?

The deposition of sediment in any locality requires that one portion of the earth's crust should be lower than another. In the theory of a solid globe this would be brought about by the elevation of a portion of the crust, while in the theory of a liquid globe by the depression of a portion of that crust.

In a viscous mass, such as the earth's interior next the crust is here supposed to be, coupled with the irregular thickness of the crust, no especial connection could be expected to exist between different vents, even if near one another, until after the lapse of considerable time — the viscidity itself preventing any rapid motion of the interior mass.

Whatever water was met, on the welling up to the surface of the lava, would naturally render the latter more liquid, so far as it entered into the lava. The intervention of water in a volcanic eruption seems to be mainly its action on the lava during its passage upwards, instead of its being the cause of the eruption. It, indeed, plays a striking rôle in volcanic phenomena, but it does not seem to be the *primum mobile*. It is difficult to see how lava in ascending to the earth's surface could reach it without meeting water somewhere on its way. When the water was met, could the results be different from those now witnessed? Does it not seem that water is the accident rather than the cause of the eruption, and do not most observers transform an effect into a cause?

It may be said that the physical evidence advanced in behalf of its essential solidity is violated by the premises and limitations chosen as the basis of the mathematical discussion; while the petrographical and geological facts demand either an interior that is liquid or one that can readily become so.

It may indeed be said with Professor Dana: "Among geological facts none appears to demand for its explanation a rigid globe. The demand has come through the supposed requirements of physical laws, studied with the aid of the highest mathematics, whose methods and conclusions are sure only when all the modifying conditions of the problem are thoroughly understood.

"It is now admitted by some of the best of physicists that no arguments have yet been presented which prove the earth to be a rigid globe, or to have a rigid crust a thousand miles or so thick; and it is also admitted by some mathematicians and physicists of eminence, including Airy, the astronomer royal, that the hypothesis of a thin crust over a liquid interior is probably the true one.

"The science of geology is, therefore, free to adopt the conclusion which seems best to suit known facts."[1]

For further discussions of the state of the earth's interior the reader is referred to

[illegible]'s papers, "On the Internal Structure of the Earth considered as affecting the phenomena of Precession and Nutation," Smithsonian Contributions, No. 240, pp. 33–48; No. 310, 16 pp.
[illegible]'s "Earthquakes, Volcanoes and Mountain-building," 1871, pp. 68–107.
[illegible]'s "Physics of the Earth's crust," 1881.
[illegible]'s "Manual of Geology," 3d ed., 1880, pp. 808–812.
[illegible]'s "Physical Geology," 2d ed., 1877, pp. 484–524.
J. H. Pratt, Nature, 1870, II, 264, 265; 1871, IV, 28, 29, 141, 344, 345; Geol. Mag., 1870 (1), VII, 421–424; Phil. Mag., 1859 (4), XVII, 327–332; XVIII, 259–262, 344–354; 1860, XX, 194–196; 1862, XXIV, 409–417, 507–508; 1863, XXVI, 342–346; 1866, XXXI, 430–435; XXXII, 17–22, 313–315; 1867, XXXIII, 10–16; 1870, XL, 10–14; 1871, XLI, 307–309; XLII, 89–103, 280–290, 400.
[illegible] Hennessy, Nature, 1871, IV, 182, 183.
A. H. Green, Nature, 1871, IV, 45, 46, 383, 384.
[illegible], Geol. Mag., 1870 (1), VII, 535, 536.
[illegible], Geol. Mag., 1870 (1), VII, 537.
[illegible] Forbes, Nature, 1871, IV, 65; III, 296–299.
A. J. M., Nature, IV, 45, 366.
[illegible], Penn Monthly, 1876, VII, 364–378, 417–431.
[illegible], Edin. New Phil. Jour., 1827–28, IV, 273–290.
[illegible], Ibid., 1828–29, VI, 84–89.
[illegible] Hilgard, Am. Jour. Sci., 1874 (3), VII, 535–546.
[illegible], Phil. Trans. 1873, pp. 147–227; 1875, pp. 1–9.
[illegible] "Volcanoes," New York, 1881, pp. 307–330.
[illegible]'s "Ideality in the Physical Sciences,"
[illegible]'s "World Life," etc., etc.

[1] "Man. Geol.," 1880, p. 812; see also Whitney's "Earthquakes, Volcanoes and Mountain-building," 1871, p. 74.

ON THE SHEDDING OF THE CLAWS IN THE PTARMIGAN AND ALLIED BIRDS.

BY LEONHARD STEJNEGER.

THE fact of the ptarmigans shedding their claws regularly every summer, seems not to have been observed personally by any of the many excellent American ornithologists, and has, therefore, been comparatively little known to them. It may consequently not be without interest to demonstrate this process, as I have material at hand which shows the procedure very plainly.

The late Professor Sven Nilsson, the famous Swedish ornithologist, was the first to discover this peculiarity in the ptarmigan. His countryman, Professor W. Meves, afterward confirmed his observations, and at the same time proved that this singular shedding of the claws also occurs in other birds of the family Tetraonidæ, as, for instance, in both sexes of *Bonasa bonasia*, *Urogallus urogallus*, and also, in the female at least, of *Lyrurus tetrix*.

As will be seen in the specimens of the *Lagopus rupestris* (a new species which I was fortunate enough to detect on the Commander islands, near Kamtschatka), shot in June and August, before shedding, the middle claw measures 18·5^mm^, while in the specimen shot on the 23d of August, and which has just thrown the old ones off, the length of the new claw is 11^mm^. More instructive still is a male, shot on the same day as it has the claws only partially shed. The old claws have become loosened from their base and are forced 2·5^mm^ out, still covering the tip of the new ones, except on two toes, from which they have already dropped off. Hence it is obvious that the process is not a pathological one, in which the nail drops off as soon as it is perfectly separate from its bed, and has ceased to receive nourishment through the blood-vessels.

Most conclusive however, is a specimen of a quite different species, *Lagopus alba*, a specimen collected by Dr. Bean, on Unga one of the Shumagin islands, Alaska. About this specimen Dr. Bean remarks in his "Notes on Birds collected in Alaska," etc., in the Proc. U. S. Nat. Mus., 1882, p. 163, as follows: "This specimen (shot on July 21st) corresponds very closely in most respects with number 33,548, a female from Norway, collected July 2

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[illegible], the claws, however, are considerably shorter than in the Norway example, and in all other specimens of *albus* in the Museum." Dr. Bean was kind enough to show me the specimen, when it was apparent that the extreme shortness of the claws was due to the fact that the bird had shed them just before it was shot, except on the right outer toe, on which the nail was so loose, however, that it dropped off, as I was a little too rough in handling it.

It will thus be seen that the shedding takes place in July or August, according to locality and other circumstances, at the time when the toes are most denuded—in fact almost wholly naked—and the dark summer plumage is most complete. The claws grow very rapidly, however, and reach their full length long before the white winter-plumage with the densely clothed toes is fully developed.

So far as known, this process is confined to the members of the family of Tetraonidæ, mentioned above, when in the wild state, but Collett, in Christiania, has mentioned a case where a quail (*Coturnix coturnix*) shed its claws in confinement, but this may have been due to some pathologic process.

I am not aware that this peculiarity has been observed in any of the American Tetraonidæ, except *Lagopus alba*, but there seems to be no reason why it should not occur, at least in species living under conditions similar to those in Northern Europe, and Northeastern Asia. It is to be expected that we will soon hear of instances from this Nearctic region also, when attention has been directed to it.

No histological investigation has been made to ascertain the causes and the development of this unusual process (at least I am not aware that any results of such an investigation have ever been published), and consequently nothing is definitely known.

As to the use which the birds derive from this extraordinary elongation of the claws, I shall only quote Professor Meves. He writes in 1871[1] as follows: "They (Lagopus and Tetrao) have, all through the winter, to struggle with the snow upon which they are forced to walk. The snow is often loose, and with a foot like that of the common fowl, they would need much greater exertion of their strength in order to keep themselves on the surface. But as the ptarmigan by having the underside of the

[1] Öfv. Vet. Acad. Förhandl., 1871, p. 772.

toes thickly coated with feathers, which can be spread out and by means of the long and straight claws—which may be compared with snowshoes—are enabled to run easily over the snow. the usefulness and the necessity of the lengthening of the is self-evident. In the genus Tetrao (=Urogallus+Lyrurus+Bonasa) the lateral horny fringes of the toes render the same excellent service, and may fitly be regarded as a kind of snowshoes. *During the summer this whole outfit becomes superfluous*, which may be the main cause of the periodical shedding." It may in this connection be mentioned, that the horny fringes in Tetrao and the thick feathering of the toes in Lagopodes also exist during the summer, at which time the toes of the latter are almost wholly denuded of feathers.

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ON THE CONSTITUTION OF SOME APPENDAGES OF THE MOLLUSCA.

BY W. H. DALL.

IT is comparatively recently that the organic chemists have devoted any time to the investigation of the constituents of invertebrate organs or appendages, especially among brachiopods and mollusks. In the rare cases in which this has been done the observations in many cases were overlooked by the biologists most interested, and the occurrence of phosphate of lime in the shells of certain brachiopods is almost a singular instance where the statement of such a fact has penetrated all the manuals and text-books.

The teeth and radula of mollusks, an apparatus extremely characteristic of several classes of that sub-kingdom, and upon which classification has been largely based for at least forty years, are commonly referred to in the text-books as "chitinous" or "horny." The jaw, which is developed in nearly all of them, is referred to in the latest general work on the Mollusks (Encyclopædia Britannica, Art. *Mollusca*, p. 641), by Professor E. Ray Lankester in the following terms: "We find almost universally present in the Glossophora a pair of horny jaws (usually calcified) developed as cuticular productions upon the epidermis of the lips." The same author refers to the radula as "a chitinous band beset with minute teeth," "a horny cuticular product," and a "horny radula or lingual ribbon."

In various papers on the Mollusca, in which the dentition has been discussed, I have (and doubtless others have) called attention incidentally to the chitinous nature of the teeth of mollusks, and also to the fact that those groups, believed to be of very ancient lineage, and to have been less altered from their early state than many others, have the teeth composed of chitinous parts cemented together and to the radula with a horny cement which dissolves in boiling liquor potassæ. This is the case in the Docoglossa and Chitons. In these the base of the radula and the above mentioned cement are probably of a truly horny constitution. In the Pulmonata the radula and teeth are of a higher character, and apparently purely chitinous, though in but few of the groups has the jaw attained this constitution.

It is well known that in some of the most highly organized gasteropods, such as Conus, the teeth are specialized, few in number, in some cases tubular, barbed and furnished with a true poison gland and duct, by which a very severe injury can be inflicted on an assailant, even a conchologist. The secretion of sulphuric acid by the genus Dolium is doubtless connected with its habit of boring the calcareous shells of its molluscan prey by means of its teeth and radular apparatus, and the secretion of such strength that it must form a very efficient solvent, and greatly hasten the desired result. It may also be used as a poison against a well-armed adversary, but this is not definitely known. The statement of Professor Lankester that the jaws of mollusks are "usually calcified," is entirely erroneous. That some of them may have a calcareous coating or reinforcement is possible, though no such case is known to me, but at any rate it must be a very exceptional occurrence.

Dr. O. Loew, well known for his chemical investigations, when connected with the Wheeler survey was kind enough to undertake, at my suggestion, some qualitative analyses of organic products, for which I furnished the materials, about 1875.

To determine the nature of the molluscan jaw a number of the jaws of cephalopods (probably Loligo) were examined. The thick horny matter yielded very slowly to prolonged boiling in dilute liquor potassæ, but after this result a pellucid portion remained retaining the exact form of the jaw and about one-third of the total volume. This was boiled in strong acids and alkalies for a long time without yielding or being visibly affected.

Dr. Loew observed that chitine when treated with dilute sulphuric acid gives a reaction of sugar, the present substance gave no such reaction, and is therefore different from chitine and probably undescribed. It is probably closely allied to chitine but may contain a relatively larger amount of nitrogen.

Having collected a large quantity of the epidermis of the common brown mussel (*Modiola modiolus* L.) it was found to consist of purely horny matter, and dissolved with great ease in liquor potassæ. The conchioline which cements the layers of the shell is probably of a more refractory nature, but difficult to isolate without much labor except in very small quantities. If the fresh mussels be put in a box in a hot place the epidermis spontaneously scales off, and may be collected without trouble.

The horny shell of a gastropod which is distinguished by not becoming calcified (*Velutina coriacea* Pallas) was found to consist almost wholly of horny matter, with a trace of phosphate and a little carbonate of lime.

A large number of the shells of a brachiopod (*Rhynchonella psittacea* Ch.) were examined, and to our surprise yielded only a bare trace of phosphate of lime, 92 to 94 per cent of carbonate of lime, and the remainder consisted of horny matter. This raises a question as to the uniformity of the presence in other brachiopods (Lingula, Discina) of the large proportion of phosphate of lime, which has been detected in several analyses.

I have brought up this subject not so much for the value of the contribution now made to it (which is small), but rather to stimulate some of our chemical friends to work in a direction far more promising for science than some which of late have been more fashionable, and to call attention to our extreme ignorance of a great class of facts which, so to speak, lie daily before us demanding a solution.

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THE THEORY OF SEX AND SEXUAL GENESIS.

BY C. M. HOLLINGSWORTH.

(Continued from page 677, July number.)

THE view taken by Simpson seems to me altogether a just one, with regard to "the origin of those varieties of double hermaphrodites in which there is an actual coëxistence upon one or upon both sides of the body, or, in other words, in the same

segment of the sexual apparatus, of both the corresponding male and female organs. We can only refer all such instances to the laws which regulate the occasional production of local duplicities in different other organs of single bodies, and at the same time confess our present ignorance of what these laws are. We know that various individual muscles, nerves, &c, are not unfrequently found double, and that in the internal organs of the body examples of duplicity in individual viscera are occasionally, though rarely observed in the heart, tongue, trachea, œsophagus, intestinal canal, &c. In the several organs composing the reproductive apparatus, instances of similar duplicity would seem to be more common than among any other viscera." That they should thus be more common is what theory would indicate without assuming that they constitute a recurrence to an ancestral hermaphrodite form.

According to Darwin the sterility of hybrids is due mainly to an imperfect development of their reproductive organs. That there should be a greater derangement of the reproductive apparatus than of other parts, in an organism which is the product of a cross between two species, is what the theory of sex here proposed would indicate. For in the reproductive organs two redundant types have to be blended; and when a cross is effected between individuals of distinct species these two types represent parts that are functionally distributed among four distinct forms.

2. General principles pertaining to the formative conditions in the embryo also suffice to explain why it is that from a common embryonic type for the species each individual normally undergoes so pronounced a one-sided development, to ultimate in the adult characters of one or the other of the differentiated sexes, instead of developing equally and imperfectly the characters or organs of both. In considering this question these two facts should be borne in mind: 1. That where the same portion of primary tissue develops into one sexual organ in one of the sexes and into a different organ in the other sex, it is impossible for both organs to be developed in the same individual. 2. That the parts of the body of the forming embryo upon which the sexual organs are immediately dependent for the conditions of their evolution, considered as a nourishing apparatus, have not the capacity for supplying the conditions requisite to the full development of all the organs of both sexes, even if they were capable of all coëxisting in a fully developed state.

The determination to the development of the male or the female sexual gland is the essential or central fact in the whole sexual development of the individual. According to the latest views of embryologists, the ovary and the testicle in the higher animals originate from somewhat different parts of the layer of primitive generative cells which forms a thickening of a certain part of the walls of the peritoneal cavity on each side, when that cavity is formed. But since there is only a single mass of primitive cells from which either an ovary or a testicle takes its rise, we need not be particularly concerned here about whether it is the same part, or somewhat different parts, of the single mass that undergoes differential development, according as one or the other kind of glands is to be the outcome. In either case it is not difficult to understand why one kind of glands only and not both kinds is normally developed. If the conditions of development, as they immediately exist in the primitive generative cells, at the time when their development begins, are ever so little favorable to that course of development which will convert some of them into ova, they are by so much unfavorable to that course which would convert them into sperm-bearing cells; and *vice versa*. That is, the conditions that are suited to determine the development of one kind of generative cells are suited to arrest any tendency toward the development of the other kind. We are here dealing with the higher types of unisexual animals, in which there is a much more active circulation of the internal medium than in the lower animals. In the latter, germ-cells and sperm-cells are sometimes developed in near proximity to each other, but never, we may be perfectly certain, without an adequate differentiation of the conditions.

As there is a physiological, and therefore histological, difference in the stroma of the two kinds of sexual glands, analogous in kind to the difference between the two kinds of generative cells, the same statement will apply to the glands as well. Furthermore, it is probable that the same adjustment of the conditions on which cell-growth and cell-division respectively depend, which tends to initiate the development of one kind rather than the other of generative cells and sexual glands, is adapted to deflect the course of evolution of all the other accessory parts of the reproductive apparatus in the direction of the corresponding sexual type. Then the later stages of the one-sided development of

the individual in some of its sexual characters, and especially in what Hunter and Darwin have called the secondary sexual characters, is determined in great part by vital correlations between the parts thus developing and the sexual glands, established through the nervous system. This is clearly shown by the effect that is produced on the development of these parts by the removal of the sexual glands.

In monœcious and diœcious plants it is the reproductive member of the composite individual that undergoes a one-sided development. And the course of development is determined by a similar bias in the formative conditions—if not extending throughout the whole plant, at least in some manner initiated and maintained at the point from which the flower is developed. The peduncle and receptacle, one or both of which parts are common to all classes of flowers, and which are necessary to the development of the sexual organs proper, have their developmental capacities in every case adapted to their required functions; and their functions in plants in which the sexes are separate consist in giving support and transmitting nourishment to a set either of male or of female flowers, but not to sets of both. A receptacle, especially, which is required to bear organs of one sex only, will admit of being smaller and of more uniform structure than one which is required to perform the double function of bearing both stamens and pistils; and a difference of a similar kind must exist between the peduncles in the two cases. As the required structure of these parts in unisexual flowers is somewhat different for the two sexes, there is thus established not only a reduction in developmental capacity of these parts, but also a sort of structural dimorphism. And as these parts are not in themselves sexual, they tend, even when developing under conditions of an exactly medium character between those most favorable to the production of the male generative element and organs, on the one hand, and those most favorable to the production of the female parts, on the other hand, to assume the form suitable to one or the other alone.

In the higher animals that bias of the formative conditions which determines the sex is probably initiated, in most cases and under normal conditions, in the ovum at the time of its fertilization; or it may even depend on the constitution which one or the other of the combining cells has, previous to their union. But it

does not become sufficiently pronounced to produce any perceptible effect until a certain stage in the development of the embryo is reached. And the sex is no doubt subject to the controlling actions of external conditions for a time after the development begins, where the conditions of development, as they immediately affect the embryonic basis of the generative organs, can in this manner be considerably modified one way or the other.

In some of the lower animals, as will be shown farther on, the sex is subject to control at a very late stage in the life-history of the individual; and to a less extent this seems to be the case also with plants.

Causes Determining Sex.—Since germ-cells are very large and sperm-cells are small, it may at once be inferred that where they are formed in different parts of the organism, the parts in which germ-cells or their producing organs are formed must be parts in which the conditions are especially favorable to nutrition; and that the parts in which sperm-cells or their producing organs are formed, must be relatively unfavorable to nutrition and favorable to cell-division. Observation shows this to be the case; and from the causes thus indicated as determining the development of one or the other or of the two kinds of generative cells or organs in different parts of the same organism, some of the causes may be inferred which act to determine the sex of the individual, where the sexes are separate, and the truth of the inference tested by the results of observation and experiment. There is evidence, however, that the sex of the individual may also be determined by the state of maturity at which the ovum has arrived before it is impregnated; and the true theory of sex must be capable of explaining this fact.

I will now give such evidence, of various kinds, as I have been able to obtain on the causes which determine the sex, for the purpose of showing its agreement with the theory of sex given in the earlier parts of this article. The hypothesis, it should be remembered, is, that it is a *relative* preponderance of the conditions on which cell-growth depends, or of the conditions on which cell-division depends, which causes the formation of the female or male generative organs or determines the sex of the individual. If, therefore, the conditions on which either factor of the developmental process depends remain constant, the requisite preponderance, one way or the other, may still result

from variations in the conditions of the other factor. It should be remembered further that both factors are required to be present in the developmental process in the formative or initial stage of the development of all organs, the reproductive organs included.

In the higher plants this initial part of the development is generally effected at or within a very short portion of the extremity of each axis. But whether it is confined to this part or not, it is universally the case in "perfect" flowers that the pistils occupy the central position, with the stamens disposed around them. And that the central position is the one most favorable to cell-growth, and the outer position the one most favorable to cell-division, is shown by the fact that in the pith of exogenous plants the central cells are the largest—the cells decreasing in size from the center outward. The conditions on which this difference depends are no doubt complex; but it is probably due mainly to the freer access of oxygen to the outer cells; since it has been shown that the oxygen consumed in these forming parts of plants is derived directly from the surrounding air, and is not brought to them in the sap from other parts; while the nitrogenous proximate compounds that enter into the formation of the extending axis are derived mainly from other parts, and the whole supply of the lower compounds of nitrogen necessary to the growth of the plant is taken in through the roots. The access of oxygen is required both for cell-growth and cell-division. But it is mainly to its nitrogenous constituents that protoplasm owes its plasticity or instability as to state of physical aggregation; and these constituents are also chemically less stable than the other constituents. The more active respiratory changes induced in the outer cells would, therefore, have the effect of causing them to divide more rapidly than the central cells; or of preventing them from growing to so great a size as that attained to by the central cells before undergoing division.

In monœcious plants it is the female flower, as a whole, that develops from a part in which the conditions of cell-growth predominate, and the male flower that develops from a part in which the conditions of cell-division predominate. In monœcious exogens, as hickory, walnut, &c., we find the female or pistillate flowers on a terminal peduncle, while the catkins of male or staminate flowers are produced from lateral buds of the same

branch. In Ricinus, the castor-oil plant, the flowers are in a short panicle, with the female flowers at the terminus of the thick main axis, and the much more numerous male flowers borne in thick bunches on small lateral branches of the main axis. In some endogens these relative positions are reversed, but only where the conditions of nutrition in the parts are also reversed. Thus in maize the staminate spikes or tassel form the terminal branches of the main stem; but they are far removed by a long and slender portion of the stem from the assimilative organs—the leaves—of the plant; while the spike of pistillate flowers that forms the ear terminates a short and thick lateral branch produced in the axil of a large leaf in the middle part of the stalk. So likewise where both male and female flowers are borne laterally on a long and tapering spike, as in Stillingia, the staminate flowers occupy or form the upper part, and the pistillate the lower part of the spike.

In the Compositæ it is generally the marginal flowers of the head that are pistillate, while the thickly-crowded flowers of the central part of the head, which are thus less favorably situated as regards nutrition, are staminate only, or in some cases perfect. The same distribution obtains also in the Umbelliferæ. Here it is often the case that the same umbel or umbellet contains the three kinds of flowers, pistillate, perfect and staminate, clearly arranged according to the conditions of nutrition. Thus in sweet cicely (*Osmorrhiza longistylus*) and parsnip (*Pastinaca sativa*) the flowers are in compound umbels, and as regards the three kinds just mentioned, have the following arrangement: The central umbellets of the compound umbel are the smallest of all and often bear small staminate flowers only. Umbellets that are neither central nor peripheral, but intermediate in position, are also intermediate in size, and generally bear small, staminate flowers in their central parts and larger, perfect flowers in their outer parts. The outer or peripheral umbellets of the compound umbel are the largest and bear small, staminate flowers in their central parts and larger, perfect and pistillate flowers in their outer parts. Here we have a regular gradation from wholly male to wholly female flowers, with increase in the size of all the accessory parts, which difference in size must result from difference in the conditions of nutrition, or growth.

While studying the inflorescence of the wild parsnip it oc-

curred to me that since in this plant the receptacle of the umbellet is somewhat projecting in the center, and since the apex of the axis in growing plants is generally the point of most rapid growth, it might be the case that this central point of the receptacle would in some instances bear fertile flowers when parts further out and intermediate in position would not. And on more careful examination I found in many instances a single pistillate flower occupying this position, but showing this remarkable peculiarity, that it was sessile upon the apex of the receptacle; and from the considerable number of flowers in the umbellet, twenty to thirty, and the fact that all the others were carried out beyond this one, by their extended pedicels, so as to partially conceal it, I had previously overlooked it in making out the distribution of male, perfect and female flowers on the umbellet.

As has just been shown, there is a strict correlation between the size of the umbellets of a compound umbel and the sex of the flowers they bear, the smallest umbellets bearing male and the largest predominantly female flowers. In Indian turnip (*Arisæma triphyllum*) there is a similar correlation between size and sex for the whole plant, the largest plants being females, the smallest (that produce flowers) males, and many of the intermediate ones monœcious. So striking is this the case that I found that when the plants are in bloom the sex can be inferred, with a great degree of certainty, from the comparative size of the plants alone. At this time the spathe so incloses the spadix on which the flowers are borne, that it cannot be determined by direct observation whether a plant bears male or female flowers, or both, except by opening the spathe. The plants reproduce by buds from corms, and by bulbs dropped from the receptacle, and are thus found most frequently in groups, the plants in the same group varying greatly in size. The large buds from the older corms produce the largest plants, and the bulbs of the previous year the smallest; these latter, however, do not produce flower-stalks the first year.

To prove the correlation between sex and size, I made examinations at one time of 213 plants, and at another of 137 plants, while they were in bloom. An inference was first made as to the probable sex of each plant, judging from its size as compared with the others of the same group, or as compared with the average size for the locality, each plant being pronounced either

male or female, and thus no attempt being made to tell from the size which were monœcious. Then by opening the spathe the inference was found to be either right or wrong, or partly right and partly wrong, and was so recorded. Of the 213 plants seventy-four were judged, from their size, to be females, which proved on examination to be such, and ninty-six were judged to be males, which proved to be such; seven were judged to be females and ten to be males, which proved to be monœcious; thirteen, mostly of medium size, were judged to be females which proved to be males; and thirteen, mostly of medium size, were judged to be males which proved to be females. Of the 137 plants fifty-seven were rightly judged to be males, and sixty-four rightly judged to be females; so that there were only sixteen out of the whole number whose sex was wrongly inferred from the size. Thus in the great majority of cases the sex was correctly inferred from the size of the plants; and in nearly all the cases where the inference was wrong the plants were of medium size, in which case there would necessarily be much uncertainty in attempting to determine the sex in this way.

Here we have, I think, very conclusive evidence that the female sex is determined by a relative predominance of the conditions of nutrition or cell-growth over the conditions of differentiation or cell-division, as compared with the correlation of these conditions in the production of the male sex. All the external conditions of development, comprising temperature, the supply of oxygen and carbon dioxide in the air, and the supply of water and other matters in the soil, are precisely the same for all the plants of each group. The only difference is, that the larger corms contain a greater quantity than the smaller ones of elaborated and stored-up proximate compounds to be organized about a single axis of growth. And from the larger aggregations of nutritive matter female plants are developed; while from the smaller aggregations male plants are developed.

The observations or experiments of Knight furnish the most conclusive evidence we have of the nature of the external conditions which act to determine the sex in plants. He found "that several kinds of monœcious plants can be made to produce solely male or solely female flowers, by regulating the quantity of light and heat under which they are grown. If the heat be excessive, compared with the quantity of light which the plant receives

male flowers only appear; but if light be in excess, female flowers alone will be produced" (Carpenter, Comp. Physiol., 1851, p. 979). According to Sachs' account of the conditions on which cell-growth and cell-division respectively depend, these results obtained by Knight agree with the theory of sex here proposed. "In the case of the buds of the higher plants their reservoirs of reserve material are the bulbs, tubers, rhizomes, parts of the stem, cotyledons and endosperm; after the complete exhaustion of these, growth ceases in the dark but continues in the light, because the assimilating organs can then produce new material. This relation of growth, which is connected with cell-division, to assimilation, is especially clear in algæ of simple structure, which assimilate in the day-time under the influence of light, while cell-division proceeds exclusively, or at least chiefly, at night. The swarmspores are also formed at night, but swarm only with the access of daylight. In some Fungi, also, the splitting up of the protoplasm in the sporangium into a number of spores takes place only in the night, the spores being thrown out on the access of light. While, therefore, in the larger and more highly organized plants assimilation and the construction of new cells out of the assimilated substances is carried on in different parts but at the same time, in small transparent plants, in which the parts where these functions are effected are not surrounded by opaque envelopes, they take place at different times" (Botany, p. 753). The conditions on which cell-division depends are no doubt present both in light and darkness, but in the light there is a predominance of the conditions of growth.

Speaking of the segmentation of the animal ovum, Stricker says: "In the fecundated egg the spermatozoa must be regarded as the agents from which the first excitation proceeds. There can be no doubt, also, that in the act of fission a high temperature plays an important part" (Manual of Histol., p. 46). This also accords with the interpretation of the results of Knight's experiments required by the theory of sex here proposed.

There is evidence of a similar kind to that now given with respect to plants, showing that in animals likewise the sex may be determined or controlled to a greater or less extent by conditions of nutrition. "According to Girou, female domestic animals bear more females when well nourished and left in repose than when much worked and on spare diet" (Allen Thomson,

Todd's Cyclop., art. Generation). But experiments that have been made on the larvæ of butterflies and moths furnish the most conclusive evidence that has yet been obtained of the determination of sex in animals by conditions of nutrition.

In the Am. Naturalist for March, 1873, an account is given by Mrs. Mary Treat of experiments on this point, both with butterflies and moths. Larvæ that were shut up in paper boxes soon after the last molt and deprived of food, nearly all developed into males; while larvæ of the same lot that were highly fed on good food as long as they would eat, nearly all developed into females. Similar experiments have been made by Gentry with moths, and with the same results; and he adds the following facts which came under his notice in the course of his observations and experiments: 1. That males are the invariable result when the larvæ are fed on diseased or innutritious food; 2. That in the fall, when the leaves have not their usual amount of sap, males are generally produced; 3. That more males are produced late in the season than females; 4. That the sexes in early life cannot be distinguished, the change being brought about late in life by the conditions of nutrition" (Abstract in *Pop. Sci. Mon.*, April, 1874, of a paper communicated to the Phil. Acad. of Sci.). In the case of the well-fed larvæ there is a greater accumulation of nutritive material to be reorganized in the metamorphosis than there is in the case of the ill-fed larvæ; while the other conditions of development, temperature and the supply of oxygen are the same for both.

The effect which the time of the impregnation of the ovum has in determining sex has yet to be considered in its bearings on the foregoing theory of sex. Girou found that if the female flowers of dicœcious plants be fertilized as soon as they are fit to receive the pollen, the seed resulting produced mainly female plants; and that if the fertilization be deferred to as late period as possible, the seeds resulting produce mainly male plants. "Starting from this idea, and supposing that the complete maturity of an ovum might be very favorable to the production of the male sex, and inversely, M. Thury, of Geneva (1863), caused cows to be impregnated, sometimes at the beginning, sometimes at the end of the rutting period. In the first case he obtained female calves; in the second male calves. The experiment was repeated by a Swiss agriculturalist, M. Cornaz, who twenty-nine times in twen-

ty-nine cases, succeeded in producing at will such or such a sex" (Letourneau, Biology, p. 312). Experiments on the effect of late fertilization of the eggs of birds had previously been made by Knight, "which," he states, "to have been frequently repeated," and which gave similar results. "When the female was kept without intercourse with the male up to nearly the time for laying, so that the eggs had advanced very far in their development at the time of fertilization, the proportion of males among the offspring was very large, commonly about six out of seven" (Carpenter, *op. cit.*, p. 979).

In the theoretical interpretation of these results, the important fact to be noted is, that the mature ovum, even without fertilization, generally undergoes segmentation in an imperfect manner before its death and dissolution takes place. Thus from the beginning of the period during which the ovum is capable of being impregnated to the time when segmentation begins, the protoplasmic mass of the ovum undergoes a gradual change from a more stable to a less stable state of aggregation as a mass. This change is no doubt accelerated by the access of the sperm-cell, at whatever time fertilization may take place. Still if fertilization takes place at a very early period, the interval of time which will follow before segmentation begins will be greater than it will when fertilization takes place at a later period. And there is evidence that during that interval the sperm-cell tends to become assimilated in its constitution to the germ-cell, and therefore, by hypothesis, to have its specific capacity or function of exciting cell-division to some extent weakened. Recent investigations have shown that the act of impregnation consists in the formation of a male "pronucleus," derived from the impregnating sperm-cell, which fuses with the female "pronucleus" of the germ-cell to constitute the single nucleus of the fertile ovum. And Hertwig points out, "that considerable difference may be observed in the occurrences which succeed impregnation, according to the relative period at which this takes place. When, in Asterias, the impregnation is effected about an hour after the egg is laid, and previously to the formation of the polar-cells, the male pronucleus appears at first to exert but little influence on the protoplasm, but after the formation of the second polar-cell the radial striæ around it become very marked, and the pronucleus rapidly grows in size. When it finally unites with the

female pronucleus it is equal in size to the latter. In the case when the impregnation is deferred for four hours, the male pronucleus never becomes so large as the female pronucleus. With reference to the effect of the time at which impregnation takes place, Asterias would seem to serve as a type" (Balfour, Comp. Embryol., Vol. 1, p. 68).

Thus when impregnation takes place at a very early period, since the ovum in its own independent course of development has not yet reached the segmenting stage, the immediate effect of the union of the female and male elements is a modification of the male element by which it is to some extent assimilated in character to the female element. In consequence there is established in the fertilized ovum at the outset a relative preponderance of the factor of cell-growth, in its developmental tendencies; and this, by the theory, determines to the production of the female sex. But where impregnation takes place at a late period, when the ovum in its development has reached the segmenting stage, its modifying action on the male element before the union is completed is less; and in consequence there is established in the fertilized ovum at the outset a preponderance of the factor of cell-division, which the male element represents; and this, by the theory, determines to the production of the male sex.

It appears, therefore, that the theory of sex and sexual genesis that is here proposed, affords a reasonable explanation of the observed effects of the time of impregnation in determining sex. And so far as all the known causes on which the determination of sex depends are incapable of being equally well explained on any other theory, they may be taken as giving support to this theory.

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THE CONDYLARTHRA.

BY E. D. COPE.

IN a paper on the homologies and origin of the molar teeth of the Mammalia Educabilia, published in March, 1874,[1] I ven-

[1] Journal of the Academy of Natural Sciences of Philadelphia. The language which I used is as follows: "I trust that I have made it sufficiently obvious that the primitive genera of this division of mammals [Mammalia Educabilia = Unguiculata and Ungulata sensu latâ] must have been bunodonts with pentadactyl plantigrade feet."

The nearest approaches to a similar anticipation on the part of other naturalists which I have been able to find, refer to the number of toes only, and are of restricted

tured the generalization that the primitive types of the Ungulata would be discovered to be characterized by the possession of five-toed plantigrade feet, and tubercular teeth. No Perissodactyle or Artiodactyle mammal was known at that time to possess such feet, nor was any Perissodactyle known to possess tubercular teeth. Shortly after advancing the above hypothesis, I discovered the foot structure of Coryphodon, which is five-toed and plantigrade, but the teeth are not of the tubercular type. For this and allied genera I defined a new order, the Amblypoda.

In 1873[1] I described, from teeth alone, a genus under the name of Phenacodus, and although a good many specimens of the dentition came into my possession since that date, I was long unable to assign the genus its true position in the mammalian class. The teeth resemble those of suilline ungulates, but I had never had sufficient evidence to permit its reference to that group. Allied genera, subsequently discovered by me, were stated to have a hog-like dentition, but their position could not be determined until the structure of the feet should be ascertained.[2]

In his explorations in the Wasatch Eocene of Wyoming, in 1880, Mr. J. L. Wortman was fortunate enough to discover nearly entire skeletons of *Phenacodus primævus* and *P. vortmani*, which present all the characters essential to a full determination of the place of Phenacodus in the system. The result is, that this genus must be placed in a special group of an order which in-

application. Thus Kowalevsky remarks (Monographie der Gattung Anthracotherium, Palæontographica, XXII, p. 1452): "So we can assume a tetradactyle foot as our point of departure, although it cannot have the least effect on the result in case the original ungulate foot should have been pentadactyle; if I have set out with a tetradactyle foot it is simply because I wish to adhere, so far as possible, to facts." This was written August, 1873, but how soon thereafter it was printed I do not know. I did not meet with it until at least a year after the publication of my paper of March, 1874, cited. Secondly, Marsh, in writing on the genealogy of the horses (*American Journal of Science and Arts*, March, 1874, p. 257), says: "A still older ancestor [of the horse], possibly in the Cretaceous, doubtless had five toes on each foot, the typical number in mammals." My paper was published during the same month as the above, but I communicated the substance of the generalization in question to the Philadelphia Academy the day it was read, Nov. 18th, 1873, which was published in the Proceedings of the Society, Jan. 13, 1874 (see p. ii).

[1] Palæontological Bulletin No. 17, Oct., 1873, p. 3; also Report G. M. Wheeler, U. S. Engineers Expl. W. 100 mer., IV, p. 174, 1877. In the figure of the superior molar teeth in this work, the last molar is misplaced.

[2] Proceeds. Amer. Philosoph. Society, 1881, p. 495.

cludes also the Hyracoidea.[1] This order realizes fully the anticipation which I expressed in 1874, for the greater number of its species are pentadactyl and plantigrade, both anteriorly and posteriorly, and have tubercular or bunodont dentition. The order to which I have referred Phenacodus, the Taxeopoda, has been already defined in these pages.[2] It includes those curious mammals the *Hyracoidea* or conies, and is divisible into two sub-orders by the following characters:

A post-glenoid process; no fibular facet of calcaneum, but an interlocking articulation between fibula and astragalus; ungual phalanges truncate....*Hyracoidea.*

A post-glenoid process; no fibular facets on either calcaneum or astragalus; a third trochanter of the femur; ungual phalanges acuminate.....*Condylarthra.*

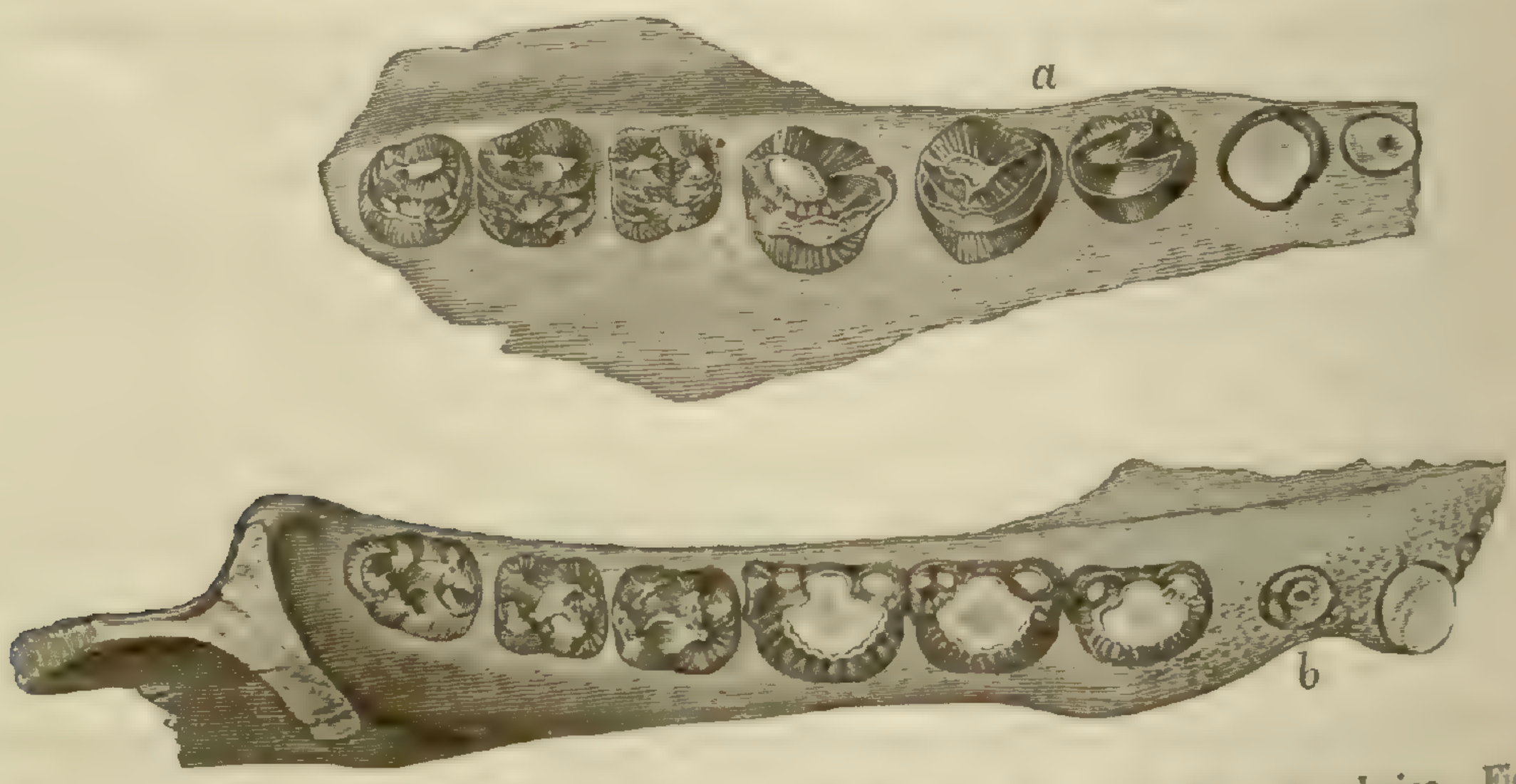

FIG. 1.—Dentition of *Periptychus rhabdodon* Cope, two-thirds natural size. Fig. *a*, superior molars from below; *b*, inferior molars from above. From the Puerco beds of New Mexico. Original. From Vol. III, Report U. S. Geol. Survey Territories.

The astragalus in the sub-order Condylarthra is absolutely undistinguishable from that of the flesh-eating groups Creodonta and Carnivora. The humerus also presents a character of the unguiculate orders, in possessing an epicondylar foramen, which is elsewhere unknown among ungulates. The humeral condyles have the generalized character of the same type as the Amblypoda, and of the lower Perissodactyla, in lacking an intertrochlear crest.[3] The Condylarthra may then be further defined as follows:[4] *Astragalus with one uniformly convex distal articular face; humerus with epicondylar foramen.* This sub-order has as yet been

[1] AMERICAN NATURALIST, June, 1882 (May 17).

[2] AMERICAN NATURALIST, 1882 (May 20th) p. 523. Proceeds. American Philosoph. Society, 1882, p. 444.

[3] AMERICAN NATURALIST, April, 1882, p. 334.

[4] AMERICAN NATURALIST, 1881, p. 1017, Nov. 29.

only found in the lowest horizons of the Eocene period, the Puerco and Wasatch, and only on the North American continent. Appropriately to this position in time, its structure indicates that it is the most primitive type of the Ungulata. A number of genera and species belong to it, and these fall into three families, which are defined as below. They conform to the definitions of the order in possessing the full mammalian number of teeth, and a third trochanter of the femur. The approximation to the Hyracoidea is greater than that of any other group of the Ungulata. That order agrees with the Condylarthra in the simple articular extremity of the astragalus, which is, however, less convex; but it has a very peculiar articulation with the anterior face of the extremity of the fibula, seen in no other group of ungulates. In the manus of the Hyracoidea the lunar bone agrees with the Condylarthra in not being divided below into two facets, as in most other ungulates, but it is peculiar in extending to the trapezoides (the intercalare), and to the unciform. In this point the Hyracoidea come nearer to the Amblypoda. In Hyrax there is also no epicondylar foramen. The three families of Condylarthra are defined as follows:

Dentition bunodont; toes 5–5; astragalus without trochlea; neck very short; premolars very simple above and below.....*Periptychidæ.*
Dentition bunodont; toes 5–5; astragalus with trochlea; neck longer; premolar teeth different from the molars above and below.....*Phenacodontidæ.*
Dentition lophodont, with crescents and deep valleys; premolars partly like molars below; neck longer?.....*Meniscotheriidæ.*

The bunodont dentition, with very simple premolars, flat astragalus and five toes on all the feet, give the Periptychidæ the lowest place in the sub-order and order, as the most generalized type known. The Meniscotheriidæ have a quite specialized dentition, and until I learned its Condylarthrous character, I was at a loss to account for the presence of such perfection in so old a type. The number of the toes is yet unknown. The family appears to have had no descendants, and is a good illustration of Dr. Kowalevsky's views as to the persistence of the "adaptive" over the "non-adaptive" types of articulation. Kowalevsky observed that the types of Ungulata, which have the carpo-metacarpal and tarso-metatarsal articulations simple and not alternating, have become extinct. In those which persisted, the metapodials articulate with two bones of the carpal or tarsal series. I have discovered that the same rule has generally applied in the ungulates

to the middle carpal and tarsal articulations. The orders with the double articulation continued, while the Condylarthra, with the single articulation, have disappeared, leaving only modified descendants. The Proboscidea, which have the same simple distal articulation of the astragalus, still remain, however, to show an exception to the generalization. They have, however, an alternation in the second series of the posterior foot not present in the Taxeopoda. The relations of the genera of these three families are as follows:

PERIPTYCHIDÆ.

In Periptychus only are the posterior feet known. The carpus is yet unknown. The successional generic modifications are seen in

FIG. 2.—*Periptychus rhabdodon* Cope, jaws represented in fig. 1 seen in profile: two-thirds natural size. From the Puerco beds. Original.

the addition of cusps to the inner sides of the premolars of both jaws, and to the true molars of the upper jaws. In Ectoconus we have the largest number of dental cusps and lobes, and in Periptychus the next. In Anisonchus the inferior premolars lose their inner ledges, and the true molars their anterior internal lobes. The molars are still further reduced in Hemithlæus, and the premolars in Haploconus.

The characters of the genera are the following:

I. Three premolars.

Fourth superior premolar like molars; inferior premolars without internal ledge. *Hexodon.*

II. Superior molars with intermediate tubercles, and tubercles anterior and posterior to the internal cusp; four premolars.

Superior molars with an external cingular cusp; inferior premolars without internal ledge ..... *Ectoconus.*

No supplementary external cusps, inferior premolars with internal ledges. *Periptychus.*

III. Intermediate tubercles wanting; four inferior premolars, without internal lobes.

Superior molars with posterior internal cusp only, besides internal V; last two superior premolars with internal lobes ..... *Anisonchus.*

Superior molars with internal V only, no other internal lobes; last two superior premolars with internal cusps..... *Hemithlæus.*

Superior molars with posterior internal cusp only, besides apex of V; fourth superior premolar only with internal lobe..... ...*Haploconus.*

IV. Superior molars unknown; inferior premolar No. IV ? with two opposed crescents and a heel.

Inferior molars with one or two pairs of opposed crescents..... *Zetodon.*

All the known species of the Periptychidæ are from the beds of the Puerco Eocene.

From the preceding table it is obvious that the species of this family present considerable diversity in the degree of complication of their molar teeth. In all of them the premolars are more or less simple, and in Hexodon they are but three in number, while in the other genera there are four.

In Hexodon Cope the type is most developed in the direction of the dental prehension. With the shortening of the jaws comes

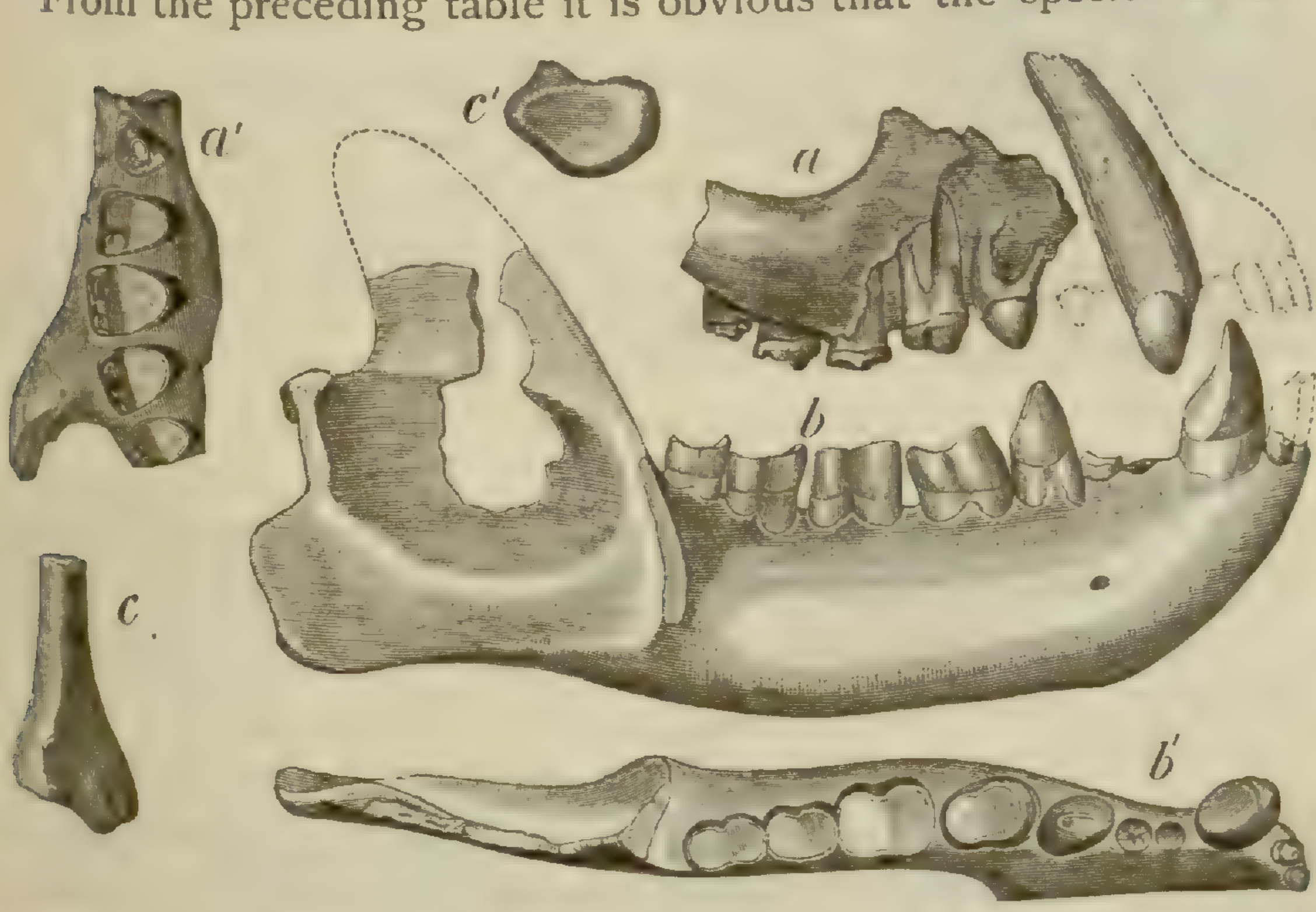

FIG. 3.—*Hexodon molestus* Cope, two-thirds natural size, from the Puerco beds of New Mexico. Fig. *a*, right maxillary bone, external view; *a'*, do. from below. Fig. *b*, right ramus mandibuli, external view; *b'*, do. from above. Fig. *c*, distal end of ? radius; *c'*, do. distal view. Original, from Vol. III, Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

the loss of a premolar. The only species, *Hexodon molestus*, is known from the superior and inferior dentitions of a single individual. It differs from the *E. ditrigonus* in the short, rounded incisive region and closely-placed incisor teeth, the small posterior superior molar, and the more robust and more vertical canine teeth (Fig. 5). It is about the size of the red fox, but much more robust. It is one of the few species of the family which is armed with large canine teeth, and evidently stood preëminent in its powers of offence and defence. In the typical specimen the teeth are all worn by the mastication of hard or tough substances, so that the structure of the crowns of the true molars is not entirely known.[1]

In Ectoconus Cope, we have the most complex structure of the molars in the family, or that the tritubercular type of superior molar is known to present. There are eight cusps on each crown, viz., one external cingular; two external; two intermediate; one internal; two (anterior and posterior) interior cingular. The typical species is the *E. ditrigonus* Cope, an animal about the size of the collared peccary. Its upper lip, and probably muzzle, are prominent, since the premaxillary bone is produced, and the small conic incisor teeth are widely spaced (Figs. 4–5). The limbs were robust, and had the general character of those of Periptychus. Thus the astragalus is flat, and the humeral condyles are wide, and resemble those of a carnivorous animal. Several individuals have been obtained by Mr. David Baldwin.

In the genus Periptychus Cope, we have the largest and most specialized forms of the family. The molars only differ from those of Ectoconus in the entire absence of the external cingular cusps (Figs. 1–2). The two genera agree in possessing internal cingular lobes of the superior premolars. The inferior premolars of Periptychus are a little more complex than in the other genera. The canine and incisor teeth are relatively small. What further characterizes the species of this genus is the extraordinary sculpture of the teeth of the entire molar series. This consists of strong grooves separated by convex ribs, which extend from the base towards and to the apex of the crown, the number be-

[1] This species is represented by a specimen which is referred by me to the *Conoryctes comma*, in the Vol. III of the Report of the U. S. Geological Survey of the Terrs., p. , and are represented in Figs. 1–5. Plate XXIII*e* of the same. Better specimens of the *C. comma* show that the canine (or ? incisor) teeth are of very different character from those of this animal.

coming less as they ascend or descend to the latter. This sculpture is unparalleled in the class Mammalia, the nearest resemblance being found in the genus Ichthyosaurus among reptiles. A weak development of this sculpture is seen in the *Ectoconus ditrigonus* on the one hand, and the *Haploconus lineatus* on the other (Figs. 1–2 and 10).

FIG. 4.—*Ectoconus ditrigonus* Cope, two-thirds nat. size; Fig. *a*, maxillary and premaxillary bones from below, retaining a good deal of the matrix. Fig. *b*, last two inferior molars worn by use. Fig. *c*, three deciduous, with first permanent molar, of a young animal. Original.

A fragmentary skull shows a postglenoid crest, and the robust posttympanic and paroccipital processes united, and leaving the meatus auditorius externus widely open below. The os petrosum is small and not inflated. The foramen ovale is not separated from the meatus auditorius below. There are a postglenoid foramen and a supraglenoid foramen. There is also a well-marked mastoid foramen. The mastoid bone is extensively exposed. The cranial walls are thick, and there is a strong sagittal crest. The cervical vertebræ are much shorter than in Phenacodus, being deeper than long, and wider than deep (Fig. 6). They are

FIG. 5.—Parts of tibia of *Ectoconus ditrigonus*; *a*, head; *b*, distal portion; *c*, astragalar facet. From individual partially represented in Fig. 3. Original; two-thirds natural size.

very slightly opisthocœlous. The caudal vertebræ are quite robust, indicating a powerful tail. Dorsals not found.

The tuberosities of the humerus are small in proportion to the size of the head. The condyle is much like that of a creodont, with internal flange and external cylinder, without intertrochlear crest or ridge. The internal epicondyle is large, and is pierced above by an epitrochlear foramen (Fig. 7*a*). The olecranon is com-

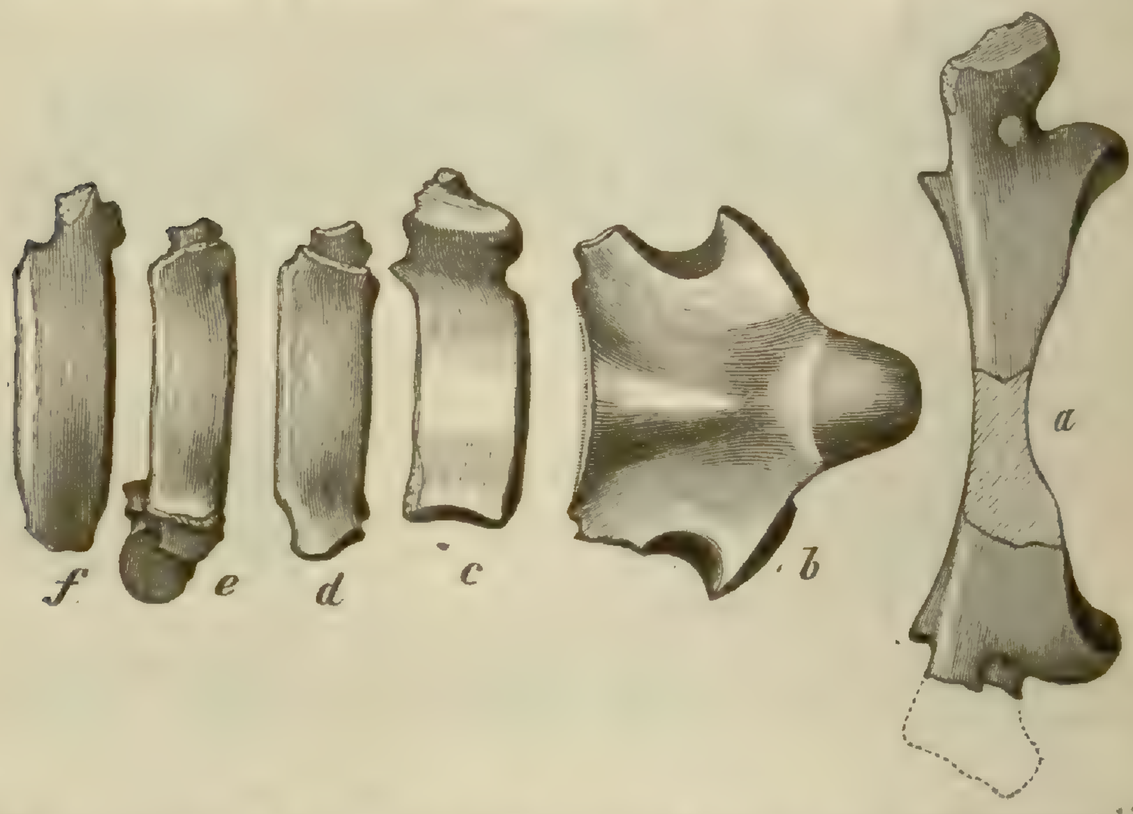

FIG. 6.—*Periptychus rhabdodon* Cope, cervical vertebræ of individual represented in figs 7 and 8, except figs. *c d e* and *f*, which belong to another individual; nat. size. Fig. *a*, atlas; *b*, axis; *c d e f*, third to sixth cervicals; all from below. Original, from Vol. III, Report U. S. Geol. Survey Terrs.

pressed. The head of the radius has a flat articulation with the ulna. Its outline is a transverse oval, narrowed at the external extremity. The scapula has a well developed coracoid hook and the spine rises abruptly from the neck (Fig. 7*h*).

In the *P. rhabdodon* the femur is not materially larger than the humerus. The great and little trochanter are well developed, and the third trochanter is situated low down, as in Phenacodus, and not opposite the little trochanter as in Creodonta (Fig. 8 *a*).

Portions of two posterior feet preserved display five metatarsals and several phalanges. The distal carina of the former is posterior and weak. The latter are rather narrow for an ungulate, but are not elongate, and are rather depressed; the distal ones are more robust, and are rather more narrowed distally than usual in Ungulata, and the neck of a broken phalange of an external digit is nearly round in section. The third digit is longest, and the

first, shortest; it is not very short, and is quite slender. Sesamoid bones are probably present. The posterior foot is that of a plantigrade animal (Fig. 8). The astragalus is much like that of the Proboscidea in form (Fig. 8 *b*). The head is moderately long and is depressed. Its distal extremity is regularly convex from side to side. The trochlea is horizontal, and is not grooved medially, but is very slightly concave. Fibular face vertical; malleolar face slightly oblique, and occupied by a deep central fossa. The head is not as convex as in Phenacodus, but is more recurved on both sides. On the external side it is so far recurved as to be continuous (in *P. rhabdodon*) with the sustentacular facet, and a part of this face is probably in contact with the cuboid, as in

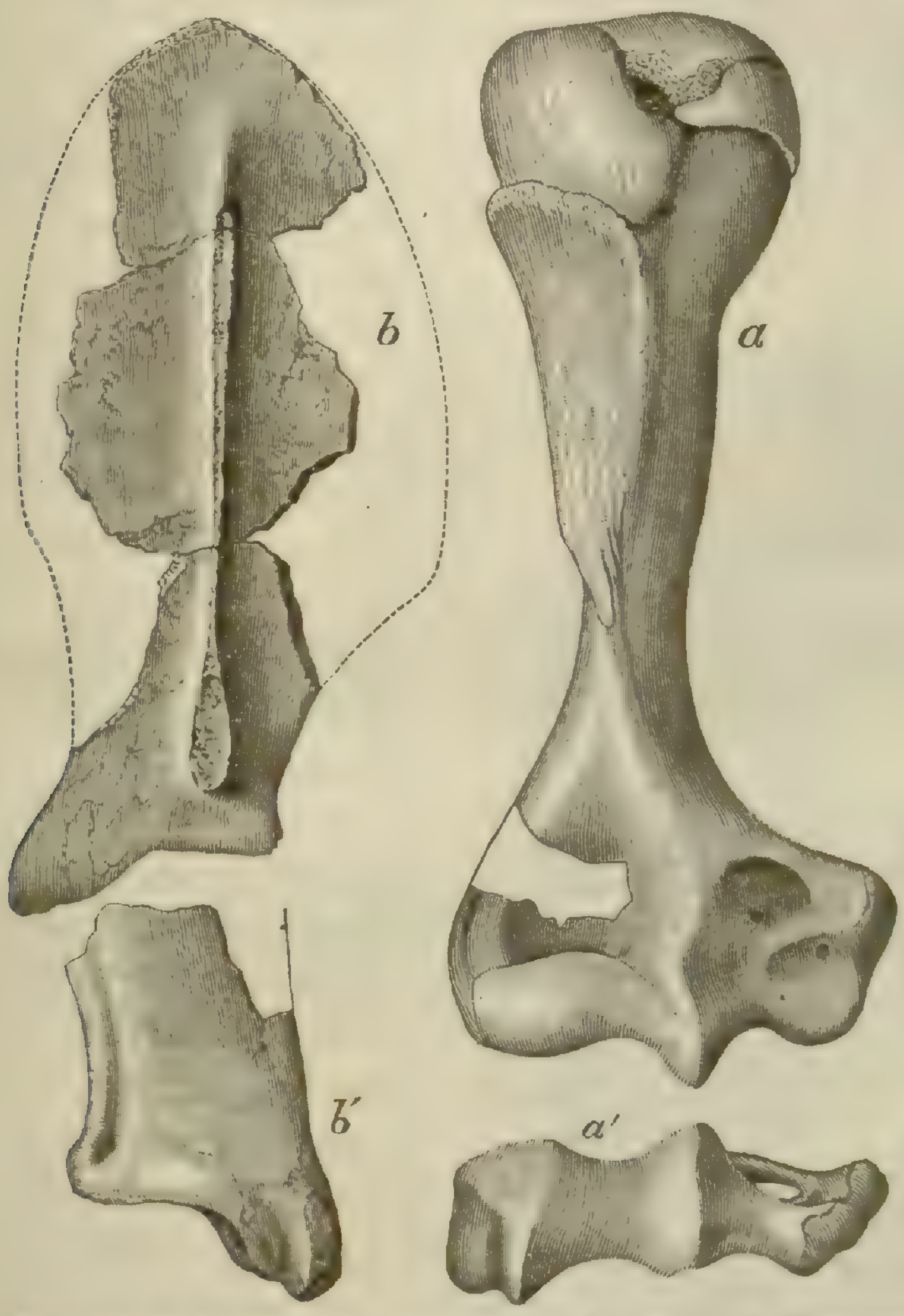

FIG. 7.—*Periptychus rhabdodon* Cope, bones of individual represented in figs. 6 and 8, except fig. *b′*, two-thirds nat. size. Fig. *a*, right humerus, with epiphysis not united, anterior view; *a′*, do., distal view. Fig. *b*, left scapula, external side; *b′*, internal side of proximal end of another left scapula. From the Puerco beds of New Mexico. Original, from Report U. S. Geol. Survey of Terrs., Vol. III.

many Creodonta, but which cannot be said therefore to overlap the astragalus, as in the Amblypoda.

I have obtained a cast of the top and sides of the cerebral cavity, and the proximal portion of the olfactory chambers, from a skull of a Periptychus in which the teeth are preserved, and prove the species to be the *P. rhabdodon*. I describe it in detail in another place, but state here that the olfactory lobes are enormous, and the hemispheres small and very flat. The *mesencephalon is entirely exposed*. It is probably the lowest known mammalian brain (Fig. 9).

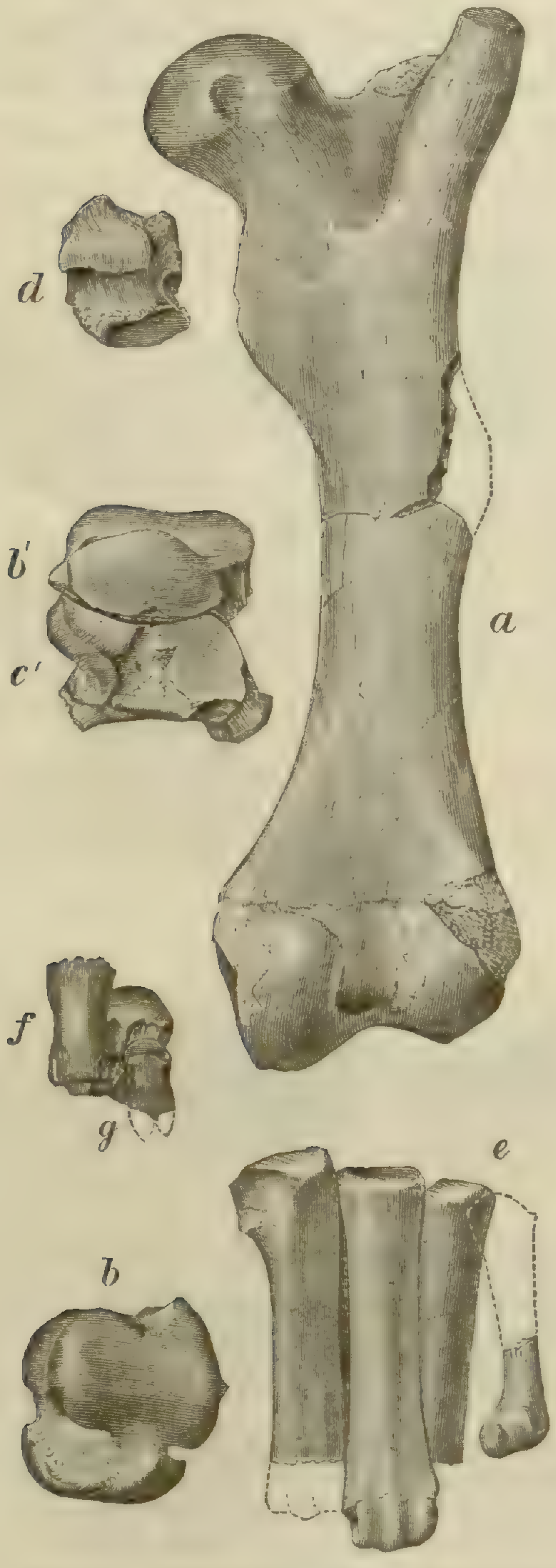

FIG. 8.—*Periptychus rhabdodon* Cope, bones, two-thirds nat. size. Fig. *a*, right femur, posterior view. Fig. *b*, left astragalus, from above; *b'*, do., distal end; *c'*, calcaneum, distal end; *d*, cuboid, from below; *e*, metatarsals, lacking M. I., from below; *f*, penultimate phalange; *g*, ungual phalange, from below. Original.

The posterior three premolars are preceded by temporary teeth in both jaws. Of these the anterior is protruded at about the same time as the first true molars, and is the last one shed, remaining until after the last true molar is fully protruded. The last milk premolar differs from the corresponding permanent one in its greater elongation. The extension is posterior, in the form of a heel with three tubercles, of which the median is very small, the crown resembling a permanent true molar, except that the anterior portion is a little more elongate and compressed. The anterior basal lobe is a mere elevation of the cingulum, as in the permanent premolar, but the internal cusp is more distinct than in the latter. The

penultimate milk premolar is more like the corresponding permanent tooth, but is a little more flattened and elongate, and the heel is not tubercular. The first milk molar is a little more compressed than the corresponding permanent tooth, and the edge of the heel is not tubercular. Otherwise they are similar.

I have dwelt on the characters of this genus more fully than on those of some of the others, as it constitutes a type of striking importance in the Early Eocene fauna. Its discovery I consider to be an important event in the history of palæontological science.

But three species of the genus are known thus far, the *P. coarctatus* (Fig. 10), *P. carinidens* and *P. rhabdodon* Cope. The first two have the jaws and teeth about the size of those of the collared peccary, while those of the last named are frequently larger than those of the white-lipped peccary. In all three species the premolars are larger than the true molars. The *Periptychus rhabdodon* must have had a peculiar appearance, and one unlike that of any known mammal. The long legs with plantigrade feet must have given it the form of a bear, but its very short neck is only paralleled by that of the elephant. While the shorter legs forbid near resemblance to that animal, and the shape of the head is very different, yet the resemblances in the figure cannot be overlooked. It had a long tail, stout at the base. It was a smaller animal than the *Phenacodus primævus*, but the head was of nearly the same size. The dental system does not furnish any weapons of offence or defence, and none are known from any other part of the skeleton. Its large premolar teeth are compressed at the apex and are capable of inflicting a severe bite. They are well adapted for cutting flesh or even of crushing bones or other hard substances. Its food may be supposed to have included substances of this character, derived perhaps from both animal and vegetable sources. The *Periptychus rhabdodon* was the most

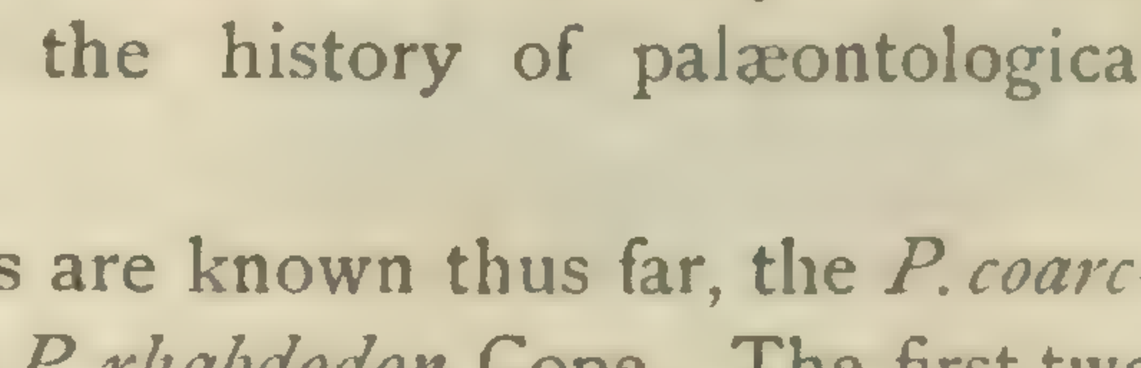

FIG. 9. Cast of superior wall of brain-case of *Periptychus rhabdodon*, nat. size. Fig. *a*, from above; *b*, left side. Original.

abundant species of the Puerco fauna, and must have had an important place in its economy.

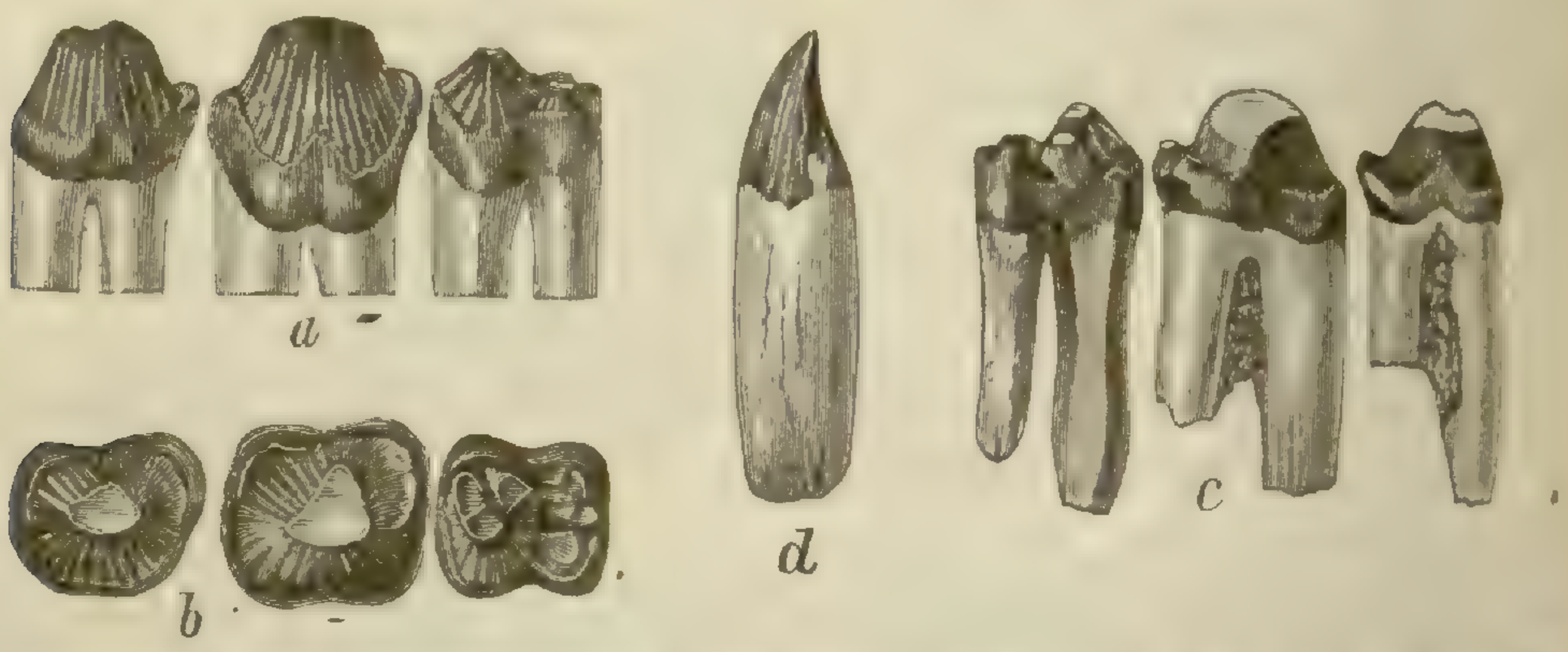

FIG. 10.—*Periptychus coarctatus* Cope, mandibular teeth, nat. size. Fig. *a*, last two premolars and first true molar, external view; *b*, do., from above; *c*, do., inner side; *d*, canine tooth. From Puerco beds, New Mexico. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

With the genus Hemithlæus we enter a series of forms with simpler molar teeth and of smaller size. The intermediate tubercles of the superior molars are wanting in this genus and in Anisonchus and Haploconus, and the inferior premolars are absolutely simple in all three. Hemithlæus is otherwise in its superior true molars a diminutive of Periptychus. The internal cusp-

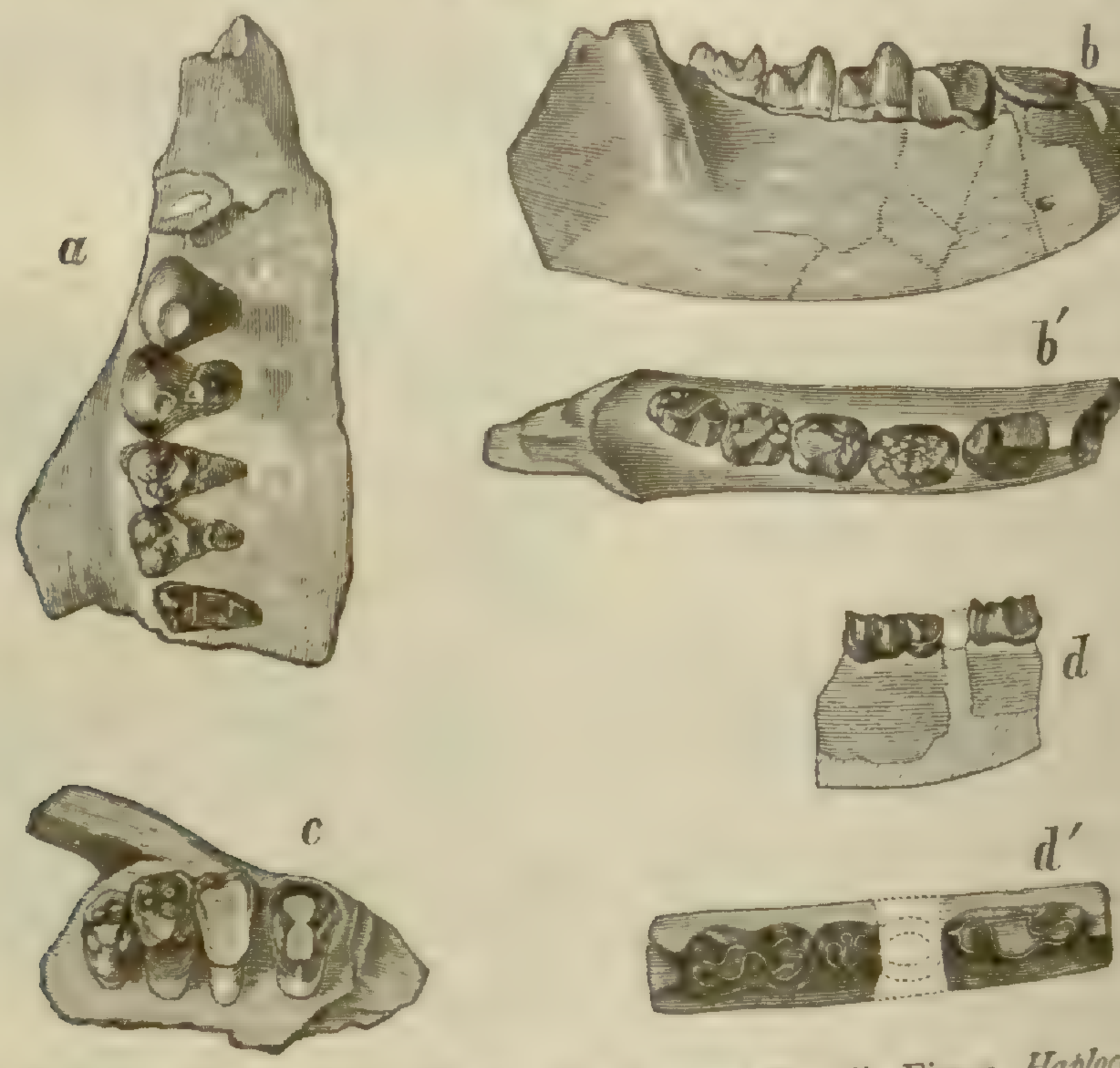

FIG. 11.—Jaws of Periptychidæ, nat. size, except fig. *d′*. Fig. *a*, *Haploconus entoconus* Cope, maxillary teeth from below. Fig. *b*, right mandibular ramus, right side, from same skull; *b′*, do. from above. Fig. *c*, *Hemithlæus kowalevskianus*, part of right maxillary bone from below. Fig. *d*, *Zetodon gracilis* Cope, part of mandibular ramus from side. Fig. *d′*, do., twice nat size, from above. Original, from Report U. S. Geol. Surv. Terrs., Vol. III.

like angle is flanked in front and behind by a cingular ridge, which is homologous with each accessory internal cusp of Periptychus. There are two species of the genus. The type, *H. kowalevskianus*, is about the size of the Virginian opossum, and is abundant. Its premolars are robust and conical (Fig. 11 *c*).

In Anisonchus the posterior cingulum of the superior true molars supports an accessory cusp, and there is no anterior cingulum or cusp. The normal internal cusp is, as in the two allied genera, the apex of a V, whose branches terminate close to the two external cusps. The superior premolars three and four, have internal cusps whose different forms distinguish two sections of the genus. In the type, *A. sectorius* Cope (Fig. 12 *a b*), the form is, as in the known species of Periptychus and Ectoconus, that of an elevated concentric cingulum; while in the *A. coniferus*, (Fig. 12 *c*) and *A. gillianus*, it is conical. The *A. coniferus* is the largest species, probably equaling the wolverine in size, while the *A. gillianus* Cope, is not larger than the *Bassaris astuta*. The *A. sectorius* is an abundant species of the Puerco fauna. Its teeth are smaller than those of a placental mammal of corresponding size, and the cranium is produced posteriorly, and is narrowed posterior to the orbits. It has a well-marked sagittal crest. Its length is about that of the skull of the red fox. Two other supposed species of Anisonchus were not larger than squirrels.

FIG. 12.—Jaws of Periptychidæ, nat. size. Fig. *a*, *Anisonchus sectorius* Cope, part of right maxillary bone with true molars and two premolars; *a'*, same, external view. Fig. *b*, right ramus mandibuli of another individual of the same species, external side; *b'*, internal side. Fig. *c*, *Anisonchus coniferus* Cope, right maxillary bone from below. Original, from the Puerco beds of New Mexico.[1] From Report U. S. Geol. Survey Terrs., Vol. III.

[1] This figure is made by combining portions of opposite sides of the same skull. In the original (Report U. S. Geol. Surv. Terrs., III, Pl. XXIV*g*, Fig. 6) the artist duplicated one of the tooth bases, an error which is now corrected.

There are four species of the genus Haploconus. They all differ from the species of Anisonchus in the entire simplicity of all the superior premolars, excepting the fourth. The internal cusp of the latter tooth presents the same variations as that of the species of Anisonchus. In the type, *H. lineatus*, the cusp is an elevated cingulum, and in *H. entoconus* (Fig. 11 *a b*) it is conical. The latter is the largest species of the genus; the former comes next in size, and is the most abundant. In both, the premolars are larger than the true molars, a character especially conspicuous in the *H. lineatus* (Fig. 13 *a*). This species is abundant, though the *H. entoconus* is not rare in the lower Puerco beds. In some of the species of this genus the posterior internal accessory cusp is so produced as to become the apex of the triangular superior molar. In the *H. xiphodon* Cope, the inferior premolars are elongate and much compressed, so as to be quite sectorial in function (Fig. 13 *c*).

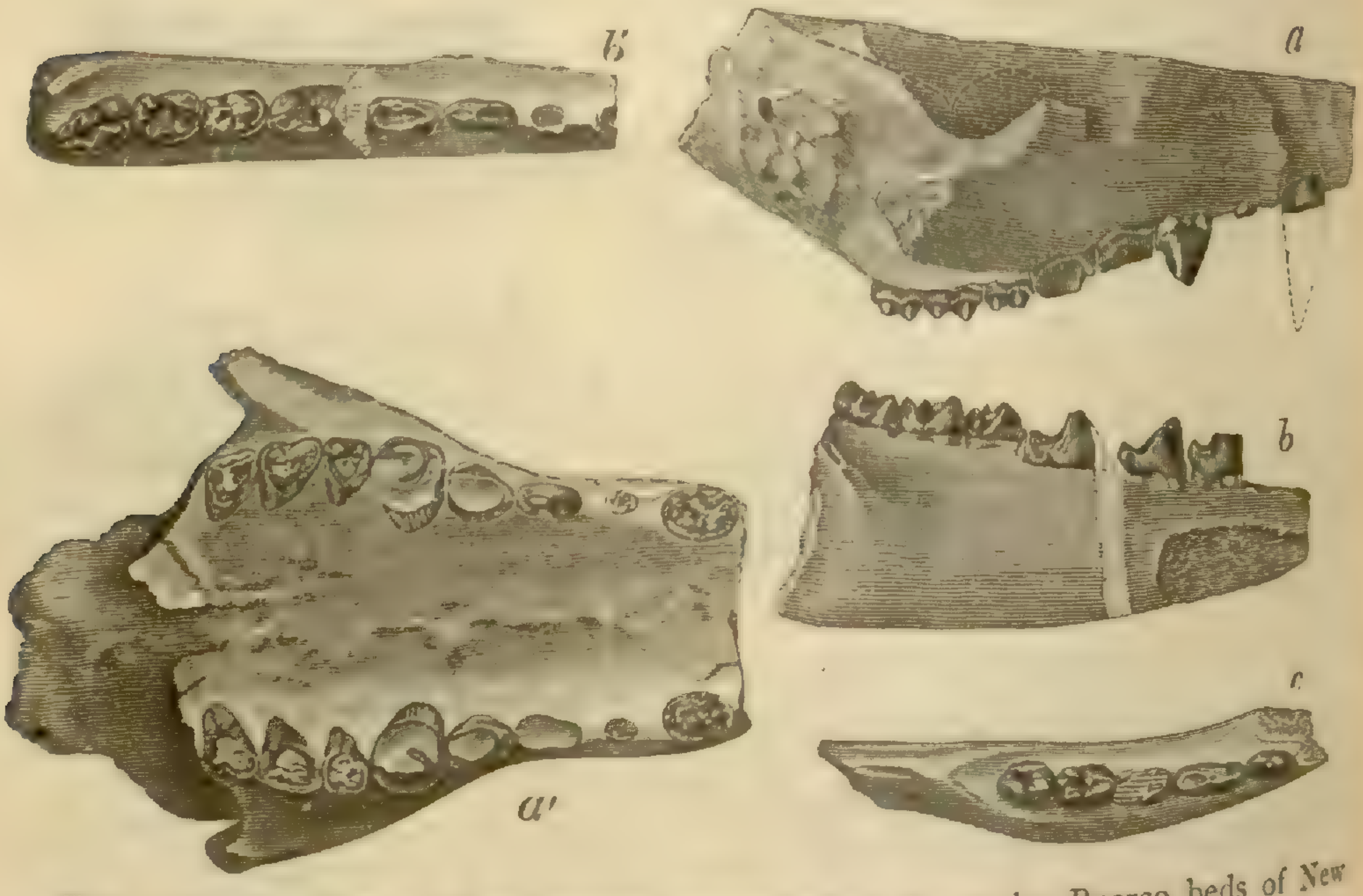

FIG. 13.—Species of Haploconus, natural size, from the Puerco beds of New Mexico. Fig. *a*, *Haploconus lineatus*, anterior part of cranium, right side; *a'*, do., from below. Fig. *b*, left mandibular ramus of same species, different individual, inner side; *b'*, do. from above. Fig. *c*, *Haploconus xiphodon*, part of right ramus mandibuli, from above. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden in charge, Vol. III.

In the genus Zetodon we have a distinct form of inferior molar. Each crown is theoretically composed of four crescents in pairs, in each of which the concave faces are presented *towards each other*, an arrangement unknown in any other genus of mammals.

In the fourth premolar there are two opposite crescents in front, like those of the true molars, but the posterior part of the crown is not double. The only species, *Z. gracilis* Cope, is a small animal with jaws not larger than those of a hedge-hog (*Erinaceus europæus*, Fig. 11 *d*).[1]

All the specimens of the Periptychidæ now known, were discovered by my assistant, Mr. David Baldwin, in New Mexico. Not only these, but the eighty species of Vertebrata now known from the Puerco epoch, are the results of the untiring, and sometimes dangerous explorations of this gentleman. Few palæontological collectors can show such a record.

(To be continued.)

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EDITORS' TABLE.

EDITORS A. S. PACKARD, JR., AND E. D. COPE.

— In one of its late issues, our esteemed cotemporary, *Science*, advocated editorially the creation of an International Scientific Association, which should have its congresses, at intervals to be determined on, in the different countries of the civilized world.

Various objections may be urged against the organization of new scientific bodies, most of which are derivable from a consideration of the imperfections of those which exist. Should such an association be composed solely of persons distinguished for actual work done in pure science? or should experts in applied science be admitted to membership? or thirdly, should any person interested in science be eligible for membership? On the determination of its founders in respect to these fundamental points, the usefulness of such a body would depend. On its probable usefulness would depend the advocacy of many of the friends of science.

The utility of the meetings of scientific workers when properly managed, is generally conceded. The occasional emergence of the student from his studio to mingle with others engaged in kindred pursuits, has a stimulating and encouraging effect. It

[1] *Correction.*—In the article on the Tertiary Marsupialia in the last (July) number of the NATURALIST, I remark (p. 687): "The extinct marsupials belong to three types as distinguished by their superior molar teeth. These are trituberculate, quadrituberculate or multituberculate." As some of the extinct marsupials are Macropodidæ, the above language should be changed so as to read, trituberculate, quadrituberculate, multituberculate, *or derivative forms*.

serves especially to keep alive an *esprit du corps*, which may counteract the effect of the isolation in which the worker in science finds himself in many communities. The associations also impress the public with the active existence of the scientific workers, in a prompt and efficient manner. And more may be learned by a few hours of personal intercourse between specialists, than in many weeks or months of exploration among books. If the associations are under proper management, they have the especial advantage of impressing the dignity and importance of the objects of scientific labor on all concerned. These are the advantages of such bodies.

The disadvantages of course would flow from bad management. If the amateur or dilettante element enter largely into such an association, its life will be feeble and its influence small. The time necessarily involved in its material support and conduct will be largely wasted. So will be the time occupied in attending its sessions. Such a body would become the prey of the advertisers of themselves or of their wares, and a field for the exercise of political manipulation.

An international association of the actual workers in pure science would have our support, should it prove to be practicable. And here we make a suggestion. An International Association of Geologists already exists. It originated in a movement in Philadelphia at the time of the Centennial Exposition. Its first meeting was held in Paris at the time of the French Exposition of 1878. Its second meeting was held at Bologna in 1881; and the third meeting will be held in Berlin on the 25th of September of the present year. The congress has been so far a success. Why should not this body be developed into the International Association of Science? It often is easier to expand than to build anew. It is less expensive. The members of the Geological Congress cannot be spared from the more comprehensive association, and they cannot attend the meetings of two such bodies.—*C.*

—— The tercentenary celebration of the University of Edinburgh was notable not only from the inherent interest of the occasion, drawing together some of the most distinguished university men of Great Britain and the continent, but from the scientific flavor pervading this popular and national occasion. According to a correspondent of the *Nation*, "so far from theol-

ogy or even letters holding the foremost place at the celebration, it was chiefly natural science that was glorified, and the scientific men who bore away the palm of applause and curiosity."

May this occasion be prophetic of the period, not now we hope far distant, when the physical and natural sciences will have an equality in rank and importance with letters and elementary mathematics in all universities and colleges; when entrance examinations to these institutions will demand as much preliminary training in the observational sciences as in language or mathematics. Then will dawn the era of a truly liberal education; an age of many-sidedness in contrast with the onesided "liberal" education of commencement dinner speeches.

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RECENT LITERATURE.

THE DUKE OF ARGYLL'S UNITY OF NATURE.[1]—This book is in effect a treatise on natural theology; at any rate it will by many perhaps be so regarded and used. It is written in a catholic spirit and from a comprehensive point of view. The style is readable, graceful, and the discussions are never dull and seldom prolix. The Duke of Argyll is somewhat of a naturalist, and a good deal of a theologian, as well as a man of affairs. He apparently accepts the doctrine of evolution, and pays profound respect to the genius and powers of observation of Darwin; and apparently uses his theory wherever it suits his purpose. As a treatise on natural theology it may then be regarded as the most modern work of the sort.

Beginning with a statement of what constitutes the unity of nature, the Duke of Argyll assumes that the monotheistic idea preceded the idea of the unity of nature, and that man's first beliefs were derived from authority. It will be seen at the outset that the plan and treatment of the book is essentially dogmatic and *a priori*, *i. e.*, theological rather than inductive or scientific.

After illustrating the idea of the unity of nature from the point of view of physics, astronomy and chemistry as well as biology, the following topics are discussed: Man's place in the unity of nature; animal instinct in its relation to the mind of man; the limits and truthfulness of human knowledge; the elementary constitution of matter in relation to the inorganic and organic; man as the representative of the supernatural; the moral character of man; the degradation of man; the nature and origin of religion, and the corruptions of religion.

The work on the whole may be regarded as an attempt to put new wine into old bottles. We should prefer to begin with the

[1] *The Unity of Nature.* By the DUKE OF ARGYLL. G. P. Putnam's Sons, New York, 1884. 8vo, pp. 571.

simpler facts of creation, to employ the inductive, scientific method; give more stress to the teleological argument, and to illustrate the unfolding or evolution of life-forms and of mental and intellectual traits, and thus arrive, by a cumulative argument, at the idea and proof of the existence of an Author of creation. This line of argument would have great force with those who tend to materialistic or agnostic views.

A curious survival of an early though still widespread view is the doctrine of the fall of man, that man did not rise from a savage to a civilized state; whereas the results of archæology and ethnology all strongly point to the conclusion that primitive man was what is usually termed a savage, and that language, the arts of life, and civilization had a natural growth. The Duke of Argyll has the hardihood to write of "the inconceivability of a first man as savage," though no physical facts are brought forward to bear out the notion. It is the dogmatism, the *a priori*, metaphysical method and curious mixture of new facts and theories with unscientific unsupported views which render this book as a treatise on natural theology a sort of half-way house, a modern structure pieced-out with mediæval bricks and mortar. A work of this sort will have to be done over again, with modern tools and materials, if it is to be adapted to the modern mind.

THE STANDARD NATURAL HISTORY.—Parts XII, XIII and XIV of this excellent work are occupied with an account of the ungulates, which has been prepared by Professor R. Ramsay Wright. It is one of the most valuable of the chapters in the work, has been prepared with care, is well written, and is authoritative as well as fresh in its mode of treatment. For the first time, so far as we are aware, we have in English some account of the new species of horse discovered by Przevalsky in Central Asia, and described as *Equus przewalskii* by Powakof, and its relations to the allied forms clearly indicated. Professor Wright says: "That *Equus przewalskii* may have been indigenous further to the west, not only on the Jaik or Ural of the present day, but even beyond, in Northeastern Europe, is highly probable, judging from the history of its companions in the steppes of Central Asia." He also quotes Powakof at length, who suggests that the primeval horse of the stone age in Central and Eastern Asia, "may have presented some such relationship to our *Equus przewalskii* as exists between the Kiang, Djiggetai and Kulan. After descending with man from the more favored hilly regions they may have together entered the plains, where human activity appears to have been of a more recent date, probably in the bronze and iron period. But however this may have been, *Equus przewalskii* is the sole wild species having close affinity with the horse (our domesticated *Equus caballus*)."

The treatment of the wild and domestic races of the ox is

PLATE XXII.

The American Bison.

excellent, though brief. The illustrations of the peccary and

The Peccary.

American bison are examples of the wood cuts, a large proportion of which are borrowed from Brehm's *Thierleben*.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*The Somali.*—The country of the Somali appears to be impenetrable at the present time to Europeans. M. Georges Revoil, who recently attempted to traverse the country, would have met with the same fate that overtook Kinzelbach at Guelidi twenty years ago, had he not escaped by night. He had a narrow escape. The escort lent him by Omar Yousef, king of Guelidi, had orders to kill him, and the watchfulness of a few friends alone saved him from becoming, like Sacconi, the victim of a treacherous night attack.

The Cameroons.—The Polish explorer Rogozinski, leaving his ship at Santa Isabella (Fernando Po) proceeded by canoe to the Bay of Ambas, at the foot of the Cameroons mountains, and fixed his station at Mundaleh or Mundoleh, one of the islands in this bay. This island was ceded to him by treaty. He then set himself to explore the great Cameroons river, the embouchure of which is a vast estuary into which empty themselves three other rivers, the Mungo, from the Cameroons mountains to the north, the Lungasi and the Qua-qua or Edee. He was not able to proceed more than sixty-five leagues up the Cameroons, on account of the opposition of the people and of the king of the country. Meanwhile his ship was destroyed by a hurricane, yet he continued to work upon the establishment of his station, and on August 13, 1883, started with M. C. Tomezek on an exploration of the Mungo. The travelers succeeded in discovering the upper course of this river and its cataracts, found two lakes in the watershed between the Cameroons and the Calabar, and explored the upper course and sources of the Rio del Rey. On Nov. 27 they marched, accompanied by 600 men of the tribe of the Beferenganyas, to the frontiers of that tribe, but their hope to penetrate into the interior was destroyed by the defeat of the Beferenganyas by the hostile Mokonyés. On his return to Mendoleh, M. de Rogozinski traversed the Cameroons mountains throughout their entire length. It is his intention, after recruiting, to again attempt to penetrate the interior and reach Lake Liba.

Socotra.—Dr. Emil Riebeck, with Dr. Schweinfurth and others, visited Socotra in 1881, and the results of their observations have lately appeared in pamphlets upon the people and the flora of the island, by Dr. Schweinfurth. The animals and plants have strong affinities with those of the African and Arabian coasts opposite, but there are also Mediterranean types, as well as forms related to those found on the Abyssinian highlands, South Africa and West Tropical Africa. The Madagascan affinities insisted on by

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Mr. Godwin Austen, of the British expedition, are doubted by the Germans.

The true Socotrans of the interior of the island are by Dr. Schweinfurth believed to resemble most closely the Mahra and Qara tribes of middle South Arabia. This is borne out by the resemblance of their language to that of the Mahras. The people are ten to twelve thousand in number, and there seem to be two races, one dark with curly hair, the other lighter with straight hair.

THE ARCTIC.—Mr. Edward Whymper states that the height of the glacier-clad interior of Greenland in lat. 70°–71° considerably exceeds 10,000 feet. He describes it as presenting, everywhere between 68° 30′ and 71° 15′, a high level ridge, so absolutely covered by snow and ice that not a crag breaks the line. Many of the highest mountains are strewn with drifted rocks to their summits.

Dr. Thoroddsen has recently explored the peninsula of Reykjanæs, Iceland. This little-known region is almost covered with lava, and perforated in every place with craters, sulphur vents, and hot springs. The interior is formed of a large plateau with hillocks, crossed by valleys, and totally devoid of vegetation and water. Dr. Thoroddsen has discovered thirty volcanoes, large and small. Only two, Thurrárhraun and Trölladyngia, were previously known. Five of these volcanoes at least have been in eruption in historical times. The eastern and southern part of the peninsula is chiefly built of palagonite breccia, while the northern is covered with doleritic pre-glacial lava-streams, which were previously supposed to exist only at Ok and near Reykjavik. In some places new lava overlays these materials. Dr. Thoroddsen examined also the geological conditions of Bordarfjardarsysla and its hot springs, traveled across the great interior table-land of Iceland to the Langjökul, and explored the volcano Skjaldbreidur, which is 3400 feet high, and has a crater 900 feet across.

The eastern coast of Greenland has by Baron Nordenskjöld been proved to be separated by a comparatively narrow and shallow cold current from a warm current coming from the south.

Lieutenant Holm, chief of the Danish Expedition to the east coast of Greenland, states that the natives of that coast, who come to the western coast to exchange their bear, fox and seal skins for European merchandise, cannot support the climate of that coast, but fall victims to disease, especially small-pox. These eastern Greenlanders are more like the Eskimo than those of the western coast. The men are tall and bearded, sometimes even good looking, and the women better looking than their western compatriots. They live a nomadic life, wandering in summer in search of hunting and fishing grounds, while in winter several

families unite to live in huts made of earth covered with turf and stones. Lieutenant Holm penetrated to 61° W. lat., and found the coast indented by deep fiords which are not marked on the maps. South of 61° N. lat., and even for many miles to the northward, the interior ice cannot be seen. The interior of the country, as viewed from a mountain 3000 feet high, consists of mountains rising 7000 feet and more above the sea.

THE PACIFIC ISLANDS.—*Mr. Forbes' Visit to Timor Laut.*—The trip of Mr. Forbes and his wife to Timor Laut has, to some extent, cleared the character of the natives of those little-known islands. Three months were passed at the village of Ritabel in the Island of Larat without any but friendly relations. The natives sold their visitors a site for a house, and did their very best to teach them their language. To this end the young women and men would bring objects and make them repeat the names. The houses seem all roof and floor. They are raised four or five feet from the ground, and entered through the floor by a trap door which is shut down at night. The *dodokan*, or seat of honor, with ornamented supports and a high carved back, is placed in front of the door. On the top of the back is an image, with a platter by its side. On this the natives place a little food every time they eat. When they drink they dip their finger and thumb in the fluid and flick a few drops upward with some words of invocation. All around the sides of the house a space for sleeping is raised some nine to twelve inches above the floor. The inmates rest their heads on pieces of squared bamboo with rounded edges, like the Chinese pillow, and recline on small, neatly made bamboo mats. In one gable is the *fœan* or fire-place, and opposite is a trellis-work platform on which is placed the cranium of the father of the house. Indian corn and other food, with sundry articles, are stored on little platforms stretching between the rafters, and the scanty clothing of the inmates is suspended from the roof by elegantly designed and carved wooden devices. The elaborate carving lavished on every article is surprising. The travelers ran a narrow escape of death for want of proper food, for the natives would give nothing away, were suspicious of gold, because they had been cheated with false gold, and only cared to purchase articles of which they felt the immediate necessity.

The name Timor Laut is Malay. The natives have no name for the group. The principal island, extending from 7° to 8° south latitude, west of 131° W. long., is Yamdena, north-east of this is Larat, and south-west of it Selaru. No land on Larat or Yamdena rises over about 200 feet, and the whole of the latter island, and probably of most of the others, as far as was visited, is coral, which forms cliffs often sixty or eighty feet high around the coast. About Egeron strait, between Selaru and Yamdena, these

cliffs are said to reach 400 feet. The soil is very thin. North and north-west of the larger island are a number of others, among them the peak of Laibobar, probably an extinct or dormant crater, and some 2000 feet high. There are no rivers or streams, the so-called fresh-water is skimmed-off holes in the coral, and is brackish. The natives are constantly at war. In Larut, Ritabel and Waitidal are at feud with Kaleobar and Lamdesar. The village of Ritabel is on the foreshore against a cliff. The houses are in irregular streets, with their gables to the sea, so that the prahus can be run up under them, though in some cases separate sheds are built for the boats. A high, strong palisade, removable by day on the shore side, surrounds the village. The ground outside is everywhere, except upon a narrow path, beset with sharp bamboo spikes. A visit to Waitidal brought Mr. Forbes into trouble. Jealous of his residence in Ritabel the Waitidal people endeavored to detain him as a prisoner, but he escaped by taking advantage of their love of raw palm-spirit. Waitidal is on the summit of a bluff, and the gateway is reached by a stair of dark red wood, the sides elaborately carved with alligators and lizards. The men vary greatly in stature, some are short and thickset, scarcely over five feet, while others reach five feet eleven inches, or even six feet or more, and are splendid looking fellows with magnificent muscles and perfect frames. The natives wear their hair combed out, and adorned with black, red and white calico bands. They dye it a rich golden color, with cocoanut ash and lime. Very few show true frizzled hair. The women also vary from under five feet to almost six, are finely proportioned and graceful in every motion. The girls are often even handsome. In color the natives are a rich chocolate brown; the forehead retreats slightly, the brows are low, and the eyes are small and narrow. There are two forms of nose, in one of which the tip is upturned and both nostrils visible in front, while in the other the tip is depressed and the *alæ nasi* much inflated. There is a tendency, in many cases, for the upper jaw and teeth to overhang the lower. The ears are small, but much disfigured by elaborate earrings.

The climate is highly insalubrious, and the travelers suffered severely from fever.

Some sixty species of birds were brought from the Timor Laut or Tenimber islands by Mr. Forbes. Among these Mr. Sclater finds twenty-three that have not been found out of that area, and twenty of these are new. The birds as a whole are Papuan rather than Australian. Many are also found in Aru, but one or two occur also in Timor and even in India.

The insects of Timor Laut show a great preponderance of Timor forms over those of Aru or New Guinea, probably because they are more influenced than the birds by the prevailing winds. Several new lepidoptera were found.

The plants of Timor Laut are mostly *coral island* plants, but with some peculiar forms, one species belonging to the flora of New Hebrides, and one to that of Australia. Cocoanuts, ferns, clerodendra, solanums and malvaceous shrubs occur. The low shrubby forest is, in some places, almost impenetrable from its spiny character. The largest trees are fig trees (Urostigma) and stereulias. The latter is near to the fire-tree of Australia, and their crowns of bright scarlet flowers, thrown out in advance of the foliage, are very conspicuous. Leguminous trees and myrtles abound; there is a pandanus, and a few palms. A green carpet of Commelyna hides the rough coral. *Artocarpus incisa* is not uncommon. There are no casuarinas, phyllode-bearing acacias, eucalypti or melanolencas.

Lieutenant Beresford has ascended the volcano of Ambrym, in the New Hebrides. The active crater is about a quarter of a mile wide, but there is a large extinct one three or four miles across, and other smaller extinct ones. All the hills seem to be mere cinder heaps.

GEOLOGY AND PALÆONTOLOGY.

The Choristodera.—We are now indebted to Dr. Lemoine, of Reims, for a general elucidation of the European form which corresponds with the American genus Champsosaurus,[1] and which has not yet been shown to be distinct from it. The osteology is described in a pamphlet published by the author at Reims under the title, "Etude sur les Charactéres Génériques du Simædosaure, reptile nouveau de la faune Cernaysieme, etc., 1884." The results obtained by Dr. Lemoine are very interesting, and quite anticipate the information which it was hoped that American material might furnish. The results of my own studies on Champsosaurus were thus expressed in 1876.[2] "As a summary of the preceding I propose to refer the genus Champsosaurus to the order Rhynchocephalia provisionally. It differs very much from Sphenodon in the non-coössification of the sacral vertebræ and non-union of the neural arches of the vertebræ with their centra, and the absence of the chordal perforations of the latter. * * On these grounds it may constitute a distinct suborder under the name of Choristodera." Dr. Lemoine states that M. Dollo has indicated to him that the form presents affinities to Sphenodon (= Hatteria),[3] and Dr. Lemoine himself finds resemblances in the vertebræ and teeth to that genus. The results of his researches in other directions, however, compel a different conclusion as to the true position of this suborder.

[1] Cope. Proceedings Philadelphia Academy, Dec., 1876. Simædosaurus Gervais, *Journal de Zoologie*, Feb., 1877.

[2] Proceedings Phila. Academy, p. 350.

[3] Etude, p. 37.

In the first place, Lemoine shows that the genus is streptostylicate, and that the quadrate bone has much the character of that of the Pythonomorpha. It can, therefore, only be properly compared with that order, the Lacertilia and the Ophidia. The single rib-heads and the separate odontoid bone are entirely confirmatory of this affinity. There is therefore no longer any propriety in comparing it with the Rhynchocephalia or the Crocodilia. Is it a Lacertilian or a Pythonomorph, or to what division of the streptostylicates is it to be referred?

Dr. Lemoine has discovered what he regards as a distinct cranial segment ("vertebra") interposed between the occipital and parietal segments in this genus. This is very remarkable, and constitutes a strong mark of distinction between the Choristodera and Lacertilia. It will depend on future investigations to show whether such difference exists between this order and the Pythonomorpha and Ophidia. In this question everything depends on the interpretation of the pieces. The new segment consists, according to Lemoine, of an "anterior basioccipital" as axis, which is surmounted by the opisthotic, and this by the epiotic on each side. It is closed above by the supraoccipital (Etude, p. 14). The segment in front of this Lemoine identifies with the sphenoidal. Its axis, then, becomes the sphenoid bone, and its lateral pieces the proötics. According to Lemoine's figure six, the latter elements meet on the middle line above, and the pariëtal lies above them. A notch on the lower part of the front margin of the so-called proötic is identified with the foramen of the trigeminal nerve.

Without access to similar specimens it is impossible to know whether any of the axial pieces of this skull is a parasphenoid or not. In any case we shall learn something by comparison with the snake and pythonomorph skull. Each of these, as is well known, presents a decurvature in front of the proötic bone, which reaches to the sphenoid or presphenoid. The foramen of the fifth nerve is posterior to this, in the position of the one assigned by Lemoine to the eighth nerve. If now we identify Lemoine's proötic with the lateral or "alisphenoid" plate of the pariëtal segment of the above orders, we have the normal number of cranial segments remaining. The "opisthotic" (fig. 4) becomes proötic, and the "anterior basioccipital" becomes sphenoid. This is the more probable identification, because in the streptostylicate reptiles, the opisthotic is largely or entirely excluded from the cranial walls, and becomes part of the suspensorium of the quadrate. Moreover, many of the Lacertilia possess ossifications of the anterior membranous wall of the brain-case in front of the true proötic, which nearly meet on the middle line above, in the manner of the anterior elements described by Lemoine.

To the resemblance which this structure bears to that of the Ophidia must be added the absence of true roots of the teeth.

These points, together with the natatory limbs, indicate that the position of this group is with the order or suborder Pythonomorpha. The characters which distinguish it are, the distinctness of the anterior pieces, which may be called, for the present, alisphenoids; the amphiplatyan vertebræ, and the presence of condyles of the phalanges. The Choristodera will be distinguished by these characters wherever placed.

The dentition is remarkably like that of the bony gar, Lepidosteus, and Dr. Lemoine has enabled me to identify specimens as to whose place I have hitherto been greatly puzzled.—*E. D. Cope.*

The Formation of Statuary Marble.—From numerous experiments conducted separately by MM. Berthelot, Bonssingault and Dieulafait, it appears that the chalk must be very rich in manganese. Fifty-six examples from the chalk of the Paris basin, operated upon last year, gave this result without exception, and twenty examples from England and various parts of Europe, have since then yielded the same results in the hands of M. Dieulafait. The presence of manganese was evident in half a gramme of chalk. Manganese is also found in a state of complete diffusion in the marbles of Carrara, Paros and the Pyrenees. Important geological consequences result from the discovery. Even as low as the lower gneiss, limestones exist, often arranged in concentric layers like the coats of an onion, whence they are called "cipolin" marbles. In some places these marbles form considerable masses and can be exploited, but more frequently occur in isolated lenticular masses, often ending in thin streaks which become lost in the enclosing rock. This arrangement proves that the cipolins are cotemporaneous with the rocks enclosing them. The examination of samples of the rocks from almost every part of Europe and from the United States, has shown manganese to be present in such quantities that it is perceptible in half a gramme, or, in at least half the cases, in a few centigrammes of the rock.

Guided by the idea, derived from chemistry, that when carbonate of lime is in presence of a salt of iron and a salt of manganese, the iron will be precipitated almost pure, while the greater part of the manganese will remain in solution, M. Dieulafait thus explains the geological process. The magma of gneiss was composed principally of silicate of lime and alumina, with a considerable quantity of lime and a sensible proportion of iron and manganese. Water circulating throughout this mass would dissolve the lime and manganese and leave the iron, and the carbonate of lime, thus freed from the greater portion of the iron would be of that clear white suitable for statuary marble, and would be deposited in concentric layers in the midst of the highly colored gneissic rocks.

THE GENUS PLEURACANTHUS.—In the AMERICAN NATURALIST for April, 1884, p. 413, I gave a brief abstract of the characters of the skull of Didymodus, and proposed to regard it as the type of a new order to be called the Ichthyotomi. I now give a plate of the skull of *D. compressus* and *D. platypterus*, sp. nov.—*E. D. Cope.*

EXPLANATION OF PLATE XXIII.

(I owe this plate to the American Philosophical Society, who will publish it in the forthcoming number of their Proceedings.)

All the figures two-thirds natural size except fig. 5, which is one-half larger than nature.

FIG. 1.—Skull from above, right frontal bone displaced and its anterior extremity broken off. Posterior apex broken from right frontal cartilage bone. *a*, frontal or supraorbital bone, that of the right side displaced; *b*, anterior nostril; *c*, postfrontal facet for palatopterygoid; *d*, frontal fissure.

FIG. 2.—Posterior part of skull of another individual, from above; *a*, occipital bone; *b*, parietal; *c*, cornua of frontal bone.

FIG. 3.—Anterior view of fig. 2, displaying section of brain case; *a*, frontal or parietal cartilage bone; *b*, sphenoid; *c*, brain cavity; *d*, frontoparietal fontanelle; *e*, hyomandibular condyle (? pterotic bone).

FIG. 4.—Anterior part of skull, from below, of a third individual, displaying orbits and postorbital processes.

FIG. 5.—Tooth of *Didymodus compressus* Newb., natural size, posterior view.

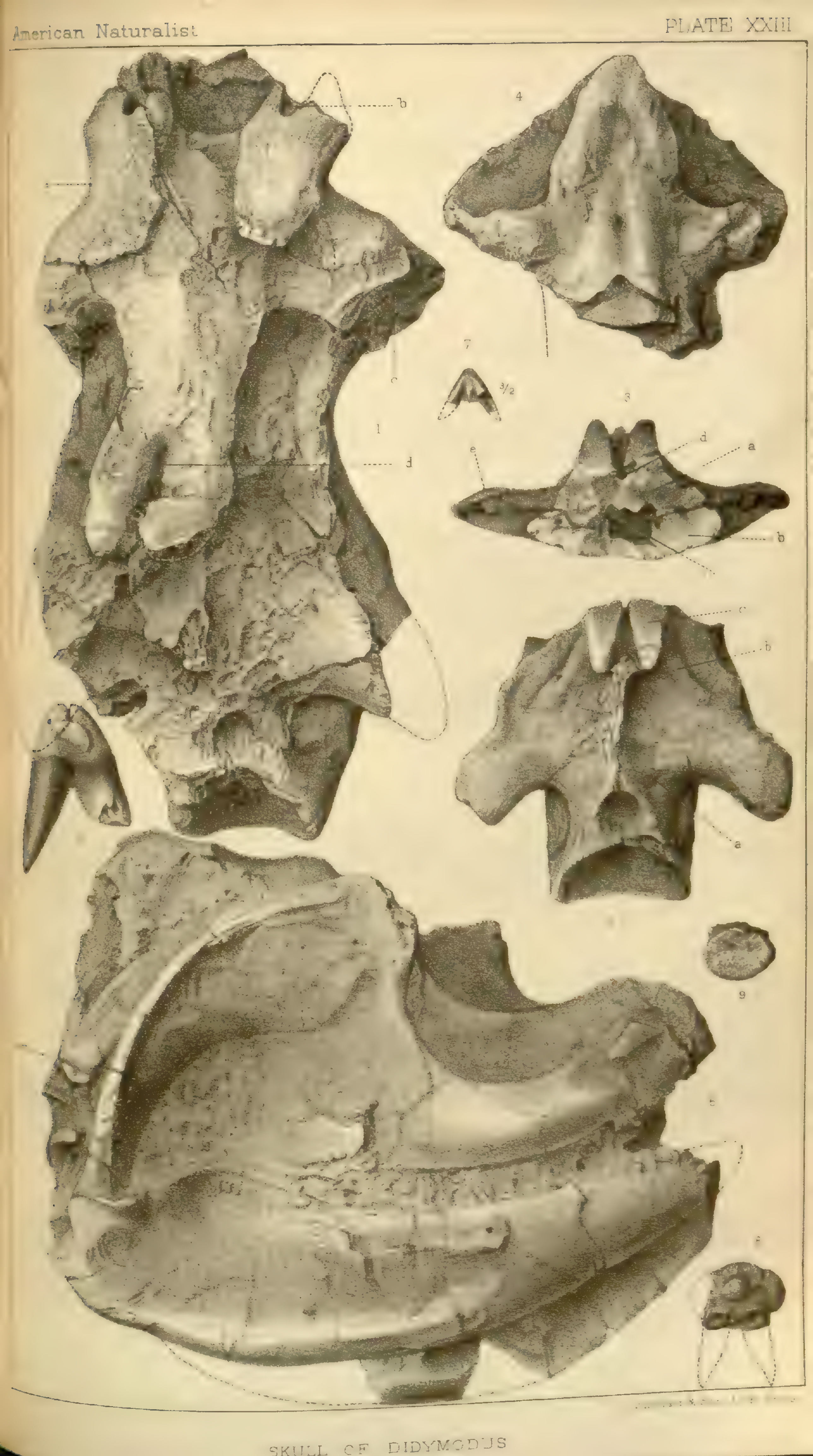
FIG. 6.—Palatopterygoid and mandibular arches of a fourth individual, from right side, with *hm*, hyomandibular.

FIG. 7.—Superior tooth of external row, without apices of two of the cusps; from the palatine bone of the specimen represented in fig. 5; one-half larger than nature, anterior view.

FIG. 8.—Tooth of *Didymodus platypternus* Cope, nat. size, from above posteriorly.

FIG. 9.—Tooth of a second specimen of *Didymodus platypternus*, from below.

ORIGIN OF CORAL REEFS.—Professor A. Geikie sums up a considerable amount of evidence which has accumulated since Charles Darwin's theory on this subject was put forth, tending to show that the theory (essentially that of growth of coral in connection with subsidence of the sea bottom) is by no means universally applicable. Semper and Rein supposed that in some cases raised masses of sand or deep-water corals are formed which afford resting places for surface-growing corals; the form of the islands, Semper held, is caused by the death of the inner parts of the colonies of corals, and by the action of the tides. Mr. J. Murray, from observations made on the *Challenger*, considers that volcanic cones, such as form most oceanic islands, tend to be reduced to submerged banks by the action of the waves; also, that the raising of the sea-bottom to such a height as to favor the growth of corals, is due to the unusually rapid accumulation near the shore of calcareous débris derived from dead pelagic organisms. These are so abundant as probably to represent upwards of sixteen tons of carbonate of lime in suspension in the uppermost one hundred fathoms of every square mile of the ocean. In the deepest water these appear to be dissolved before reaching the bottom, but they accumulate on shallow bottoms, and thus furnish



SKULL OF DIDYMODUS

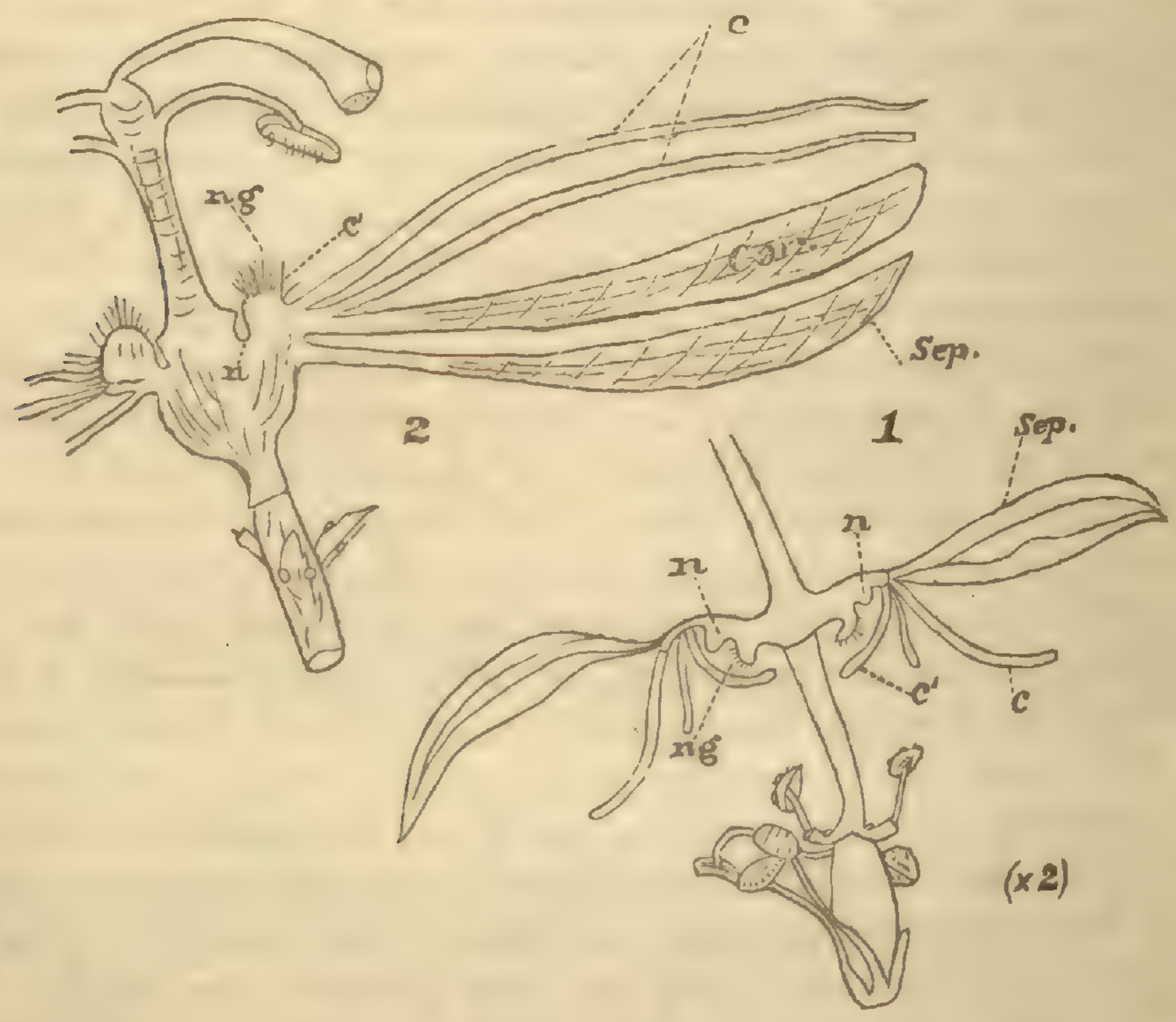
foothold for sponges, various cœlenterates, &c., which in return die and bring up the bottom to the level of reef coral growth. This, taking place on a submerged bank, would produce the atoll-form of island, which would tend to widen by death inside, and by the consequent solution of the dead coral by the carbonic acid of the sea-water. Special cases, such as elongate chains of atolls, *c. g.*, the maldives, or submerged banks, as the chagos, fall in with the theory. Barrier reefs are similarly explained as due primarily to growth upon accumulations of débris around land.—*Journ. Roy. Microscopical Society, April.*

GEOLOGICAL NEWS.—*Carboniferous.*—Dr. R. H. Traquair (*Geol. Mag.*, Feb.) describes *Aganacanthus striatulus* from selachian spines found in the Blackband ironstone of Borough Lee, near Edinburgh.——In the January number of the same magazine, Dr. Traquair describes *Ctenacanthus costellatus*, a shark from the Lower Carboniferous rocks of Eskdale, Dumfriesshire. It appears to be a Cladodont. In the same issue Dr. Traquair describes *Elonichthys ortholepis*, a ganoid fish from the Lower Carboniferous of Eskdale, Dumfriesshire.—— Mr. J. Young notes upon the hinge line of *Spirifera trigonalis*, a denticulated structure like that upon the hinge line of Arca. He regards these denticles as originally formed of aragonite, which is harder than calcite. In the fossils, however, the aragonite has decayed, and has been replaced by a coarser calcite (*Geol. Mag.*, Jan.).——At a recent meeting of the London Geological Society, J. W. Davis described the fishes from the Yoredale series at Leyburn. Of the thirty-four species twenty are identified with known Carboniferous limestone forms, one, *Megalichthys hibberti*, is a coal-measure species, while the remaining thirteen are described as new. Eight of these are regarded as types of new genera.——Dr. E. Tietze (Jahrb. Kais. Kon. Geol. Reichanstalt, 1884), contributes an extensive account of the geology of Montenegro. Twenty-three peaks rise to elevations varying from 2000 to 2500 meters. All the principal formations from the palæozoic to the quaternary can be identified with tolerable certainty, but their members are not so well made out. The palæozoic strata consist largely of black or quaternary strata, occur east of Dulcigno, east and north of the Scutarie-see, and at various isolated points. Marine neogene strata are only found between Dulcigno and the coast, and fresh-water strata of similar age do not enter the boundaries of the little principality. The various tertiary strata are grouped along the Adriatic shore, and include nummulitic beds. The Cretaceous strata occupy the largest area, while in the north the Trias is largely developed.——Among the most recent of the memoirs of the Museum of Comparative Zoölogy is an account by C. E. Hamlin, of the results of an examination of the Syrian molluscan fossils, chiefly from Mount Lebanon, collected by Dr. Merrill and Mrs. Bird. Of the twenty-

five Gastropoda, seventeen are new, and of the thirty Lamellibranchiata sixteen are new. The shells are from the Tertiary, Cretaceous and Jurassic.

BOTANY.[1]

ADDITIONAL NOTES ON PASSION FLOWERS.—The following notes and drawings of Passiflora, kindly furnished me by Professor Wm. Trelease, of Madison, Wis., are of interest, and should have appeared in connection with my paper on *Passiflora lutea* in the July NATURALIST.—*Aug. F. Foerste, Granville, Ohio.*



Sections of passion flowers. 1.—*Passiflora gracilis.* 2.—*P. incarnata* (diagrammatic). *n*, nectar gland; *ng*, nectar guard; *c'*, inner corona; *c*, outer corona; *cor.*, corolla; *sep.*, sepals.

"*Passiflora gracilis.*—There is apparently good provision made for crossing, as nectar is secreted by the gland, but the stamens are reached by the very strongly recurved stigmas, so that close (self) pollination occurs about as soon as the flower opens. This results in fertilization, so that all flowers produce fruit. Close pollination, if it should not succeed in the above manner, is sure to occur, as the flowers close at night and so press anthers and stigmas together."[2] Bot. Gardens, Cambridge, Mass.

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

[2] This power of self-fertilization does not exclude crossing, which is provided for in the secretion of nectar and possibly by prepotency in the pollen of other flowers, if one may reason from the cases in which this peculiarity is demonstrable. As Mr. Henslow suggests (Trans. Linn. Soc., 2d ser., Bot., I, p. 366) the greater necessity for self-fertility [in case crossing is not effected] here than in related species is to be found in the fact that *P. gracilis* is an annual.

Passiflora incarnata.[1]—The three clavate styles radiate outward, curving downward so as to bring their bilobed brown stigmas between the anthers, though they usually stand a little higher and farther from the center of the flower. From the action of bees and wasps, nectar appears to be secreted between the inner row of short filaments, and the base of the column. Large and small bees and wasps visit these flowers and alighting on the colored corona creep in beneath the anthers and insert their tongues in the space surrounding the column or between the bases of the short filaments. In doing this they brush first stigma, then stamen; having begun thus they circle around the column, coming in contact with all the anthers in succession. Small beetles seem to prefer creeping in between the two whorls of long filaments, which they "feel" with their long mandibles. For some reason most of the flowers fail to fruit here, though the plant is wild and they are abundantly visited by bees and wasps, especially the latter. The distance between stamens and pistils and the corona is so great as to enable all but humble bees to creep about on the latter without coming in contact with the anthers or stigmas. Bees collecting pollen creep about, back downward, on the anthers, and often touch the stigmas." Dawson's Sta., Alabama.

A NEW SPECIES OF MOSS.—I send you the description of a new species of moss which has been named by Monsieur Renauld, of Tarbes, France, an eminent bryologist. In my studies of American mosses I came across two species which seemed to be undescribed. This is one of them:

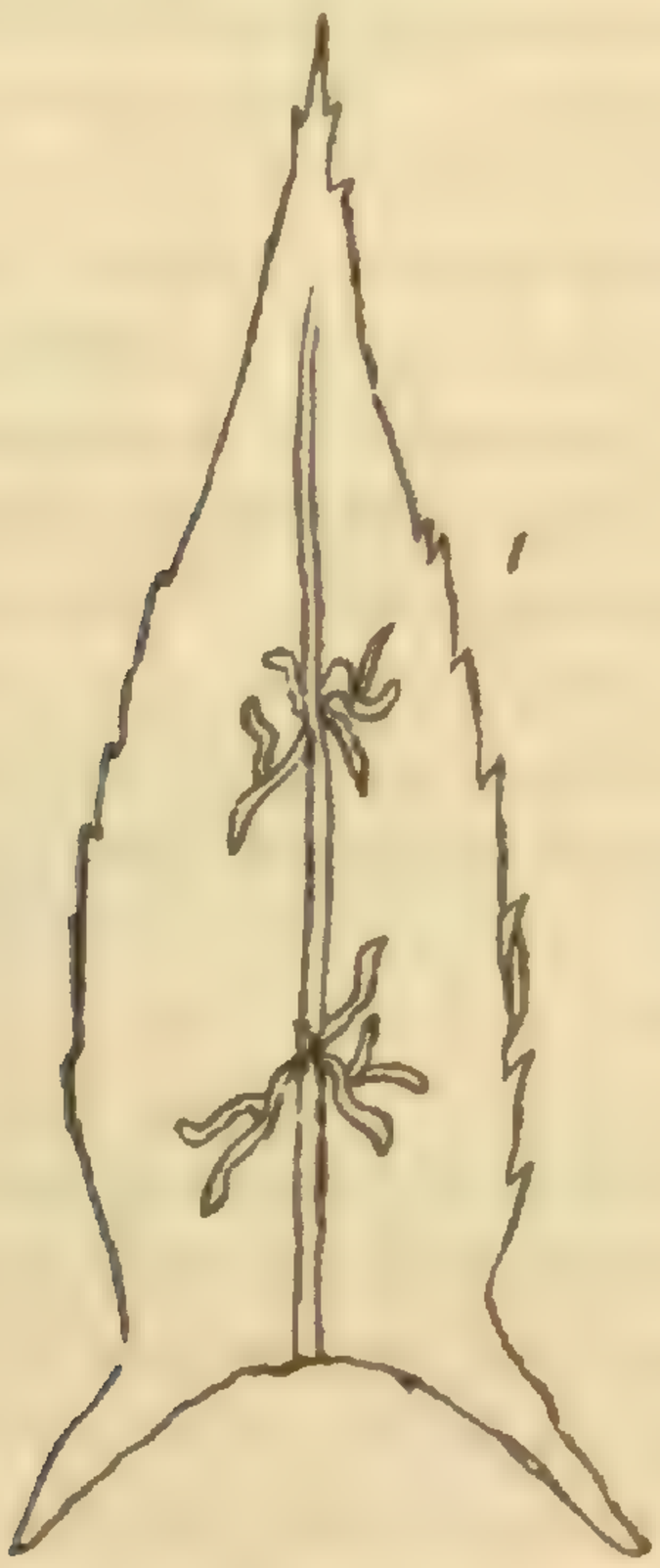
Hypnum (Amblystegium) *Barberi*, Renauld, species nova.—Monoicum, dense cæspitosum. Caulis erectus 2–4 cent. longus rufo radiculosus subpinnatim ramulosus ramuli sæpe eruti fastigiati. Folia erecta, parva (½–1^{mm} longa) lanceolata sensim acutata, decurrentia, ad partem inferiorem remote et *ad basin acute serrata*, apice subintegra. Costa crassa usque ad apicem continua, *dorso radiculis rufo-purpureis ornata*. Rete *subdento fere hypnoideo*, cellulæ subvermiculares obtusæ—8–12 longiores quam latæ, virides, basilares hyalinæ laxiores subhexagono-quadratæ. Flores masculi parvuli, numerosi, 4–8 antheridia. Perichætium radicans, folia externa ecostata apice recurva interna majores erecta tenuiter costata margine sinuosa. Capsula in pedicello purpureo lævi 3–4 cent. longo, suberecta, vix curvata, collo distincto instructa. Operculum convexo-conicum apiculatum et *sæpe rostellatum*. Annulus angustus *simplex*. Peristomium magnum, pallide luteum, membrana basilaris elata, processus subintegri. Cilia . . . .?

Habitat in loco humido, provinciæ Utah, Am. bor.

The other moss, which I found in Fairmount (west park),

[1] AM. NAT., XIV, p. 362.

proved to be a new variety of *Amblystegium serpens* L., which M. Renauld has called var. *Barberi.*



1.—Folium.

2.—Capsulum et operculum.

Specimens of the Utah species are enclosed.—*E. A. Barber, 4101 Walnut street, Philadelphia, Pa.*

THE FERTILIZATION OF PEDICULARIS CANADENSIS.—Although the fertilization of the genus Pedicularis has received considerable attention from European botanists, there are several points which *P. canadensis* illustrates which do not appear to have been noted. This flower is very common about Lansing, Mich., growing on high dry banks where there is but little shade. The yellow variety is about one-third more common than the purple.

The *modus operandi* of the fertilization of this species does not differ essentially from that of its English representative, *P. sylvatica*, which was described by Dr. Ogle in the *Popular Science Review* for 1870. The upper part of the tubular corolla projects forward forming a hood which contains the stamens and pistil. Lubbock[1] describes the rest in the following words: "The anthers open on their inner sides, and the edges of the open anther cells on the one side of the flower exactly correspond with and are applied to the corresponding edges of the anthers on the other side of the flower; each pair of anthers thus forming, as it were, a closed box. The outer sides of the anthers are slightly attached to the walls of the hood. But the sides of the hood are somewhat too near together to admit the head of the humble bee, and the insect, therefore, in order to reach the honey, pushes them a little apart, thus opening the anther box and letting down

[1] "British wild flowers in relation to insects," p. 141.

a little shower of pollen which is prevented from spreading by the fringe of hairs on the lower edge of the anther, and thus falls on to the head of the bee, at the very spot which a moment before had touched the stigma, and which will again touch that of the next flower she visits."

The "path-finders" of the flowers of this genus have been described by Dr. Kerner in his interesting treatise on "Flowers and their Unbidden Guests," although he makes no mention of *P. canadensis*. The inside of the lower part of the corolla is studded by numerous short, sharp bristles toward the mouth of the corolla. These form an effectual barrier against any insect passing its tongue to the nectar *via* the short route; were it not for this the fertilizing mechanism would be but seldom utilized, as the humble bees could reach the nectar without poking their heads between the sides of the hood. Ants and other undesirable visitors are excluded by long hairy trichomes pointing outward.

There is a point in the structure of the flowers of *P. canadensis* of which I find no mention as occurring in the European species. It is the curvature of the hood of the corolla; a device which materially aids the bee in reaching the nectar. Supposing a person standing with his back to the stem of the plant, the hood, in the great majority if not all cases, curves to the left. In all instances observed, the bees took advantage of this and lit upon the left.

The flowers are more largely visited by species of bumble-bees (Bombus) than any other insect. It is by them that the most of the flowers are fertilized. In one instance observed, a single bee visited one hundred and forty-four flowers in succession, and further observation convinced me that this was less than the usual number visited at one time. As the flowers are arranged spirally on the stem of the plant, the bee usually alights upon the lower flower and follows the spiral upward. In some cases a bee would come to a plant just after another had left it, but would seldom try more than one or two flowers. Finding the nectar gone from these, it seemed to realize that all on the plant had been plundered, and left for greener pasu res

The next most numerous visitors are butterflies of the family Hesperidæ, which during the later portion of the flowering season visit it freely. It is doubtful, however, to what extent they aid in fertilization, as in many cases they do not bring the fertilizing mechanism into use. The same doubt exists as to the fertilizing benefit of the humming birds which visit it to a certain extent. Probably in the case of the latter the prickly path-finders are of but little use. Besides the Hesperidæ a few *Colias philodice* were observed.

In the *Popular Science Review* for 1870, p. 41, Dr. Ogle describes the manner in which humble bees rob the flowers of the cow-wheat by biting through the calyx, and adds: "The very

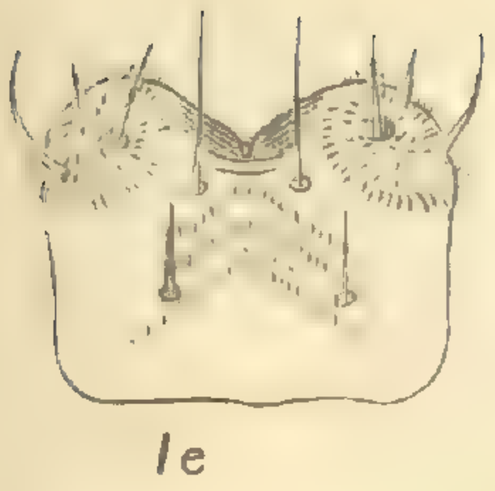
small calyx admits of this robbery, whereas in red rattle (*P. sylvatica*) the large leafy calyx acts as a safeguard." While this may be and doubtless is true of the English Pedicularis, it is not so of our species; notwithstanding the leafy calyx, a large number of the flowers of *P. canadensis* are bitten in just this way. Dr. W. J. Beal informs me that he has observed the same thing in *P. lanceolata.*

This species illustrates an interesting point in regard to the relative time of secretion of nectar and the opening of the flower. In most flowers it is naturally supposed that the nectar is not secreted until the corolla is about to open. Dr. Ogle has shown that this is the case in the cow-wheat. In *P. canadensis*, however, the bee and butterfly visitors habitually plunder the buds by thrusting their tongues in between the folds of the corolla. Very often they thus plunder buds in which the corolla projects less than a quarter of an inch from the calyx, at least several days before the flowers will open. They certainly would not do this did they not obtain nectar. That a certain amount of honey is also secreted after the corolla falls off is shown by the number of ants which visit the empty calyxes, as well as the occasional honey bees which visit them.—*Clarence M. Weed, Lansing, Mich.*

ENTOMOLOGY.

Habits of an aquatic Pyralid caterpillar.—The habits of the caterpillars of the Hydrocampinæ, a group of Pyralid moths, are unusually interesting, and deserve special attention in this country. We quote from Guenée the following account of them: "The principal title of the family of Hydrocampidæ to the notice of observers, resides in the habits of their caterpillars. Our three most popular entomologists, Réaumur, De Geer and Lyonnet, have observed and described them with all the details fitted for a subject so curious, and have not, so to speak, left anything for their successors to do; I will then give here a hasty analysis of their works. These caterpillars live on the leaves of several aquatic plants, Nymphæa, Potamogeton, Lemna, Stratiotes, Callitiche, etc., and as most of these plants are, in part, submerged or floating, or at least surrounded with water, it is necessary for our larvæ to have exceptional means of passing through the water, and even of living in almost constant contact with it. It is this which nature has provided, not in a uniform manner, but by varying its means with its ordinary fecundity."

The larva of Cataclysta, he says, feeds on leaves too small to enable it to be contained between them, it therefore constructs a cylindrical tube of silk, and strengthens it with leaves placed on the upper side. The case differs from that of Hydrocampa in that the tube it constructs is not like a sheath and formed of two bits of leaves, but is broadly cylindrical or oval, and strengthened all around by small leaves of Lemna. Moreover the caterpillar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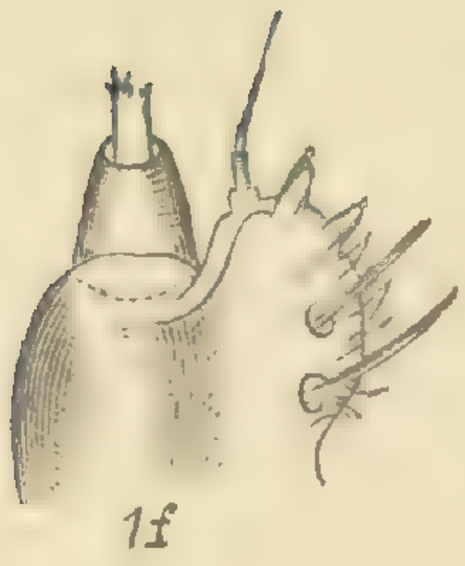
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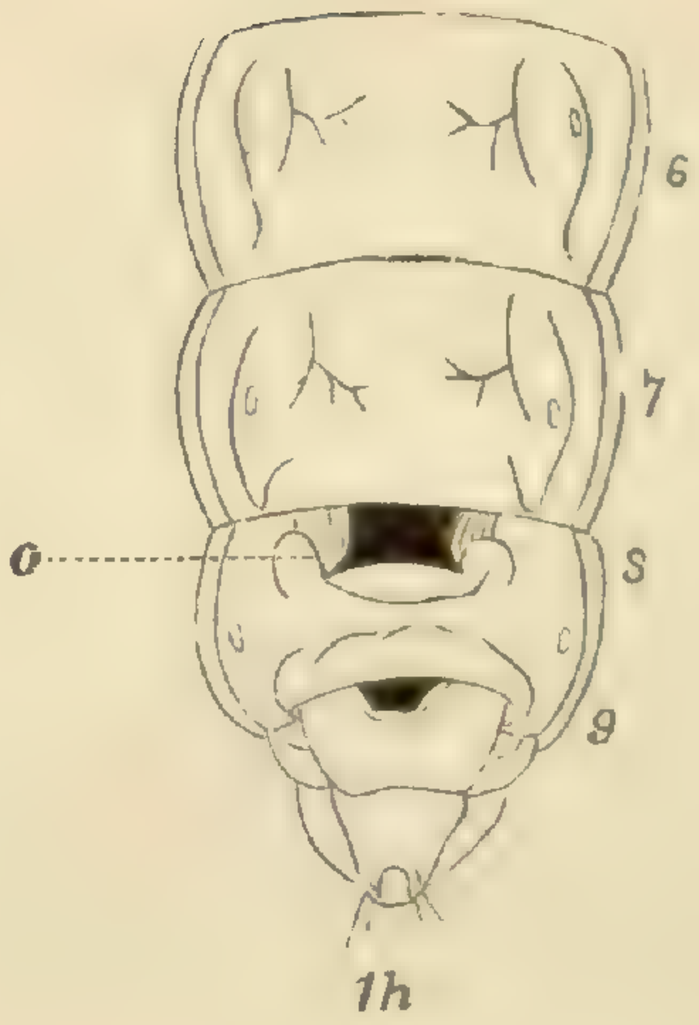

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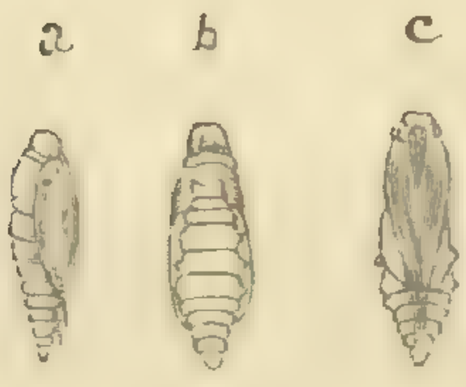

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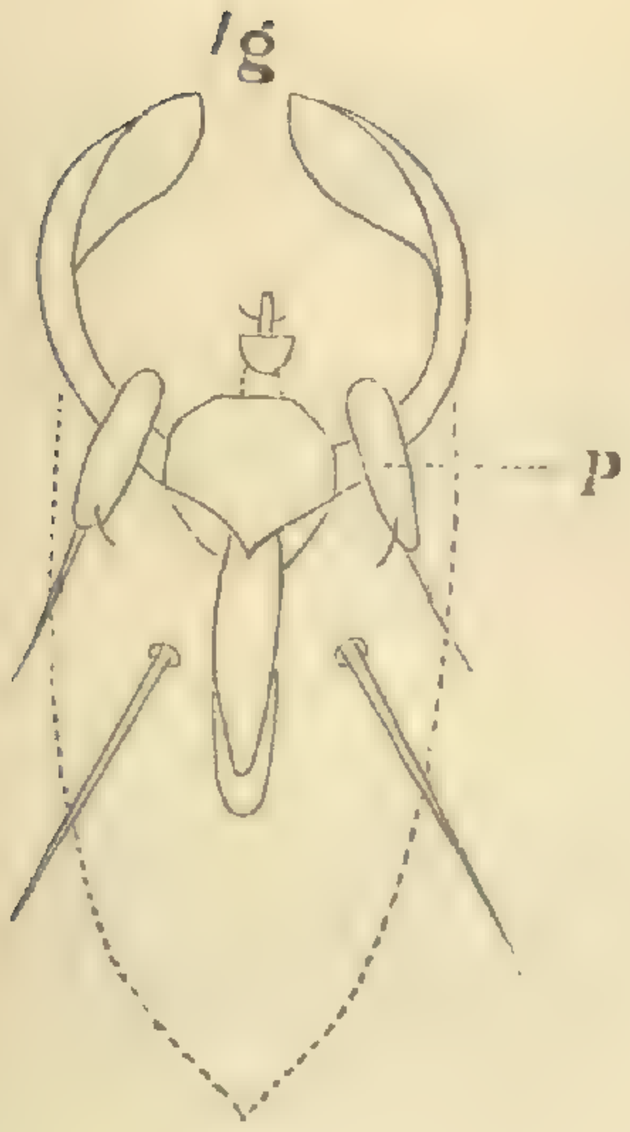

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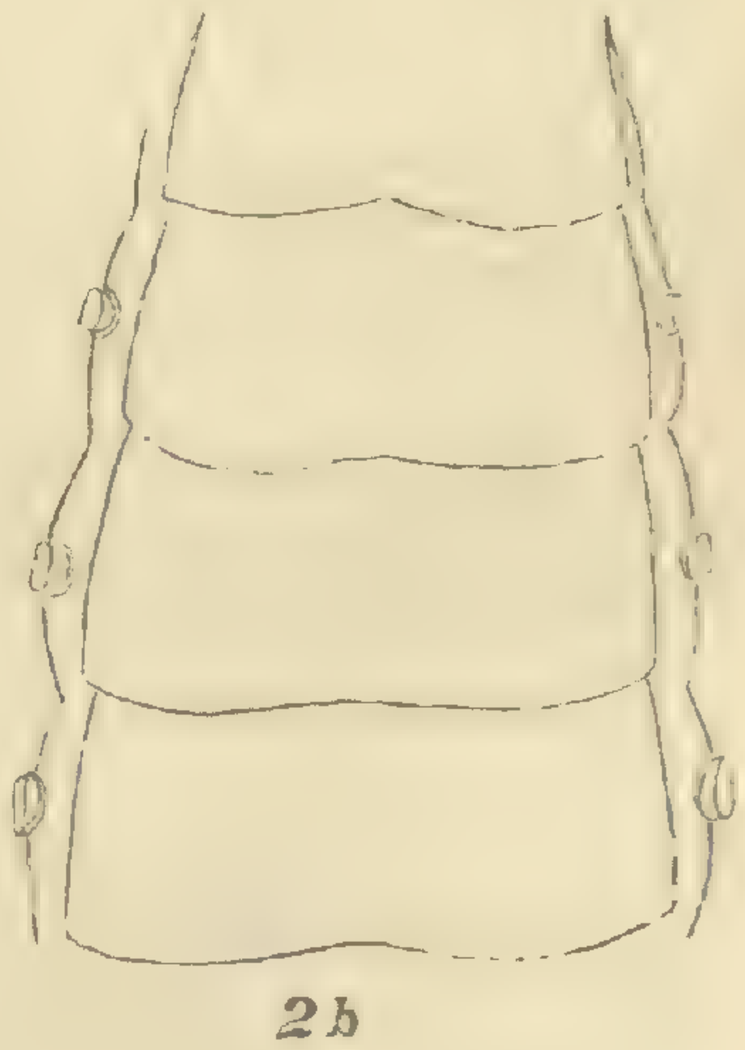
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Transformations of *Hydrocampa formosalis*.

lives submerged in the water and attached to the under surface of floating leaves. Its case serves as a cocoon within which to pupate, and it is attached to some aquatic plant. The chrysalis is soft, with the ventral sheath prolonged to the end of the abdomen.

The most curious caterpillar is that of Paraponyx, living on plants wholly submerged; it is provided with gills which allow them to decompose the air contained in the water; and they are, as De Geer showed, truly amphibious, because they are provided at the same time with stigmata to respire ordinary air, like other caterpillars.

The caterpillar appears, at first sight, as if furnished with respiratory filaments of different lengths, three or four arising from a common tubercle. It is the only lepidopterous larva known to be provided with tracheary gills.

The chrysalis lives also wholly submerged, constructing between the submerged leaves of the plant which nourishes it, a cocoon composed of a double lining of silk, wherein it changes into a chrysalis. The imago has to pass through the water on leaving its cocoon, so that it is at the beginning of its existence also amphibious.

The last genus, Hydrocampa, has caterpillars which are rather thick, attenuated at each end, flattened beneath, with a small retractile head. They live under the leaves of pond lilies in a pod-like sac formed of two bits of leaves stuck together at their edges.

The accompanying drawings, made by Dr. C. F. Gissler, undoubtedly represent a Hydrocampa larva. I found it in great abundance May 20, 1882, in its case, made from the leaves of *Menyanthes trifoliata*, in a swamp at Providence, R. I. I failed to prepare a full description either of the larva or pupa, but think that the figures on Plate XXIV, prepared by Dr. Gissler, will enable it to be recognized. I have introduced a figure of the moth, which was observed in great numbers flying over the surface of the water, many being drowned. The larvæ (Fig. 1) were observed living between two pieces of Menyanthes leaves, fastened together on the sides. The pod-like sac was oblong, but quite irregular in shape. The caterpillar was dull in color and active in its habits, thrusting its head and three following segments in and out of its case. Fig. 1 represents the worm in its case of natural size; 1*a*, the caterpillar enlarged about six times; 1*b*, an antenna; 1*c*, 1*d*, the mandibles; 1*e*, the labrum, much magnified; 1*f*, the maxilla; 1*g*, the labium, and *p*, the palpus; 1*h*, the end of the body, dorsal view, showing at *o* a large cleft which can be closed by two lateral fleshy lobes and a posterior fleshy bead; on the succeeding segment is a smaller cleft; the spiracles are seen on the sides of the same segments.

The few caterpillars which I carried home began to spin a

cocoon within the case from June 4–10th; the moths being noticed June 12–13th.

The pupa (Fig. 2–2*c*), 2, natural size, bulges out considerably on the 4th and 5th abdominal segments. There are only three pairs of spiracles, *i. e.*, on the 2d, 3d and 4th abdominal segments. One of these spiracles (highly magnified) is represented at 2*c*; their relations to the body at 2*b*.

The moth was not directly raised from the pupa, but the former were so thick that I have little doubt but that the Hydrocampæ captured at the same spot a few days after the larvæ were found, were the imagines of the larvæ under consideration. Seeking for them the next year, none were to be found, though very prolonged search was not made for them for want of time.

The moth found so abundantly, and seen on the following summer at the same date as above recorded, was *Hydrocampa formosalis* of Clemens (Fig. 3. The drawing is a very poor one).

We have in this country four species of Hydrocampa, five of Cataclysta and five of Paraponyx, and it is to be hoped that many years will not elapse before the larvæ, at least those of the latter-named genus, will be discovered. It is hoped that this note will serve to draw attention to these very curious insects.—*A. S. Packard, Jr.*

Notes on Salt-water Insects, No. III.—Our first article on this interesting subject appeared in the Proceedings of the Essex Institute, Salem, VI, 1869; a second article was published in the *American Journal of Science*, I, Feb., 1871. The present contribution will be a brief one, being a description of a dipterous larva found in the ocean Aug. 28th, on the coast of New Jersey, and forwarded to us alive by Professor A. E. Verrill several years ago; and also of a new species of mite, received at the same time and from the same source.

The body is white, long and slender, cylindrical, tapering gradually from the penultimate segment towards the head; there being twelve segments behind the head. The segments are smooth, but thickened at the hinder edge, the sutures being distinct. The tegument is very thin and transparent, allowing the viscera to be easily distinguished. The terminal segment of the body is conical; seen from beneath it is nearly one-quarter longer than broad, the end subacute and deeply cleft by a furrow which diminishes in size and depth to beyond the middle of the segment, where it fades out. This conical extension is flattened vertically. Above from the middle

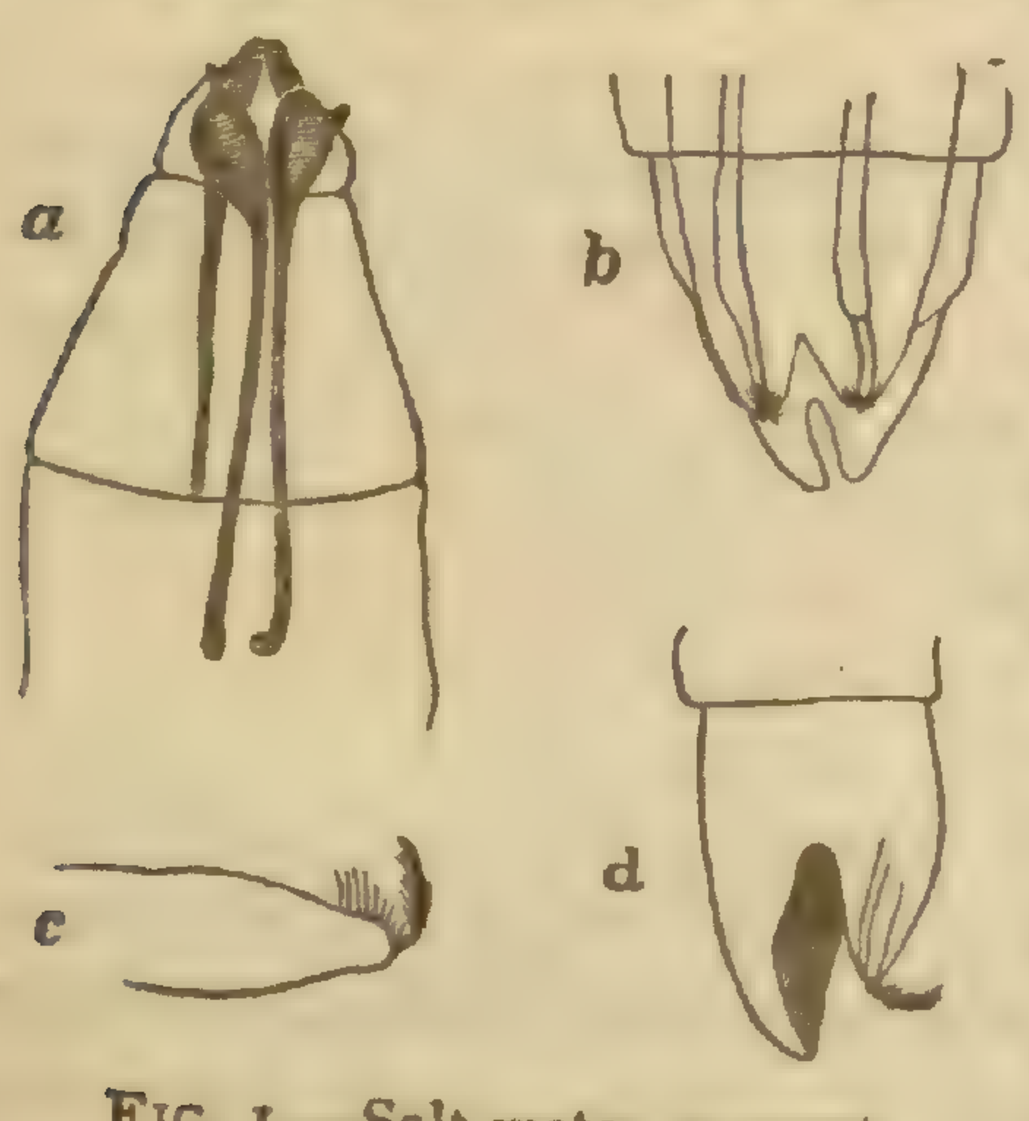


Fig. 1.—Salt-water maggot.

of the same segment project two supra-anal, conical, fleshy, respiratory tubercles, one-fourth the length of the entire segment, which separate and close together at the will of the animal. These two tubercles (*b*) give rise to two main longitudinal tracheæ which extend to the head; they end in a tuft of fine setæ.

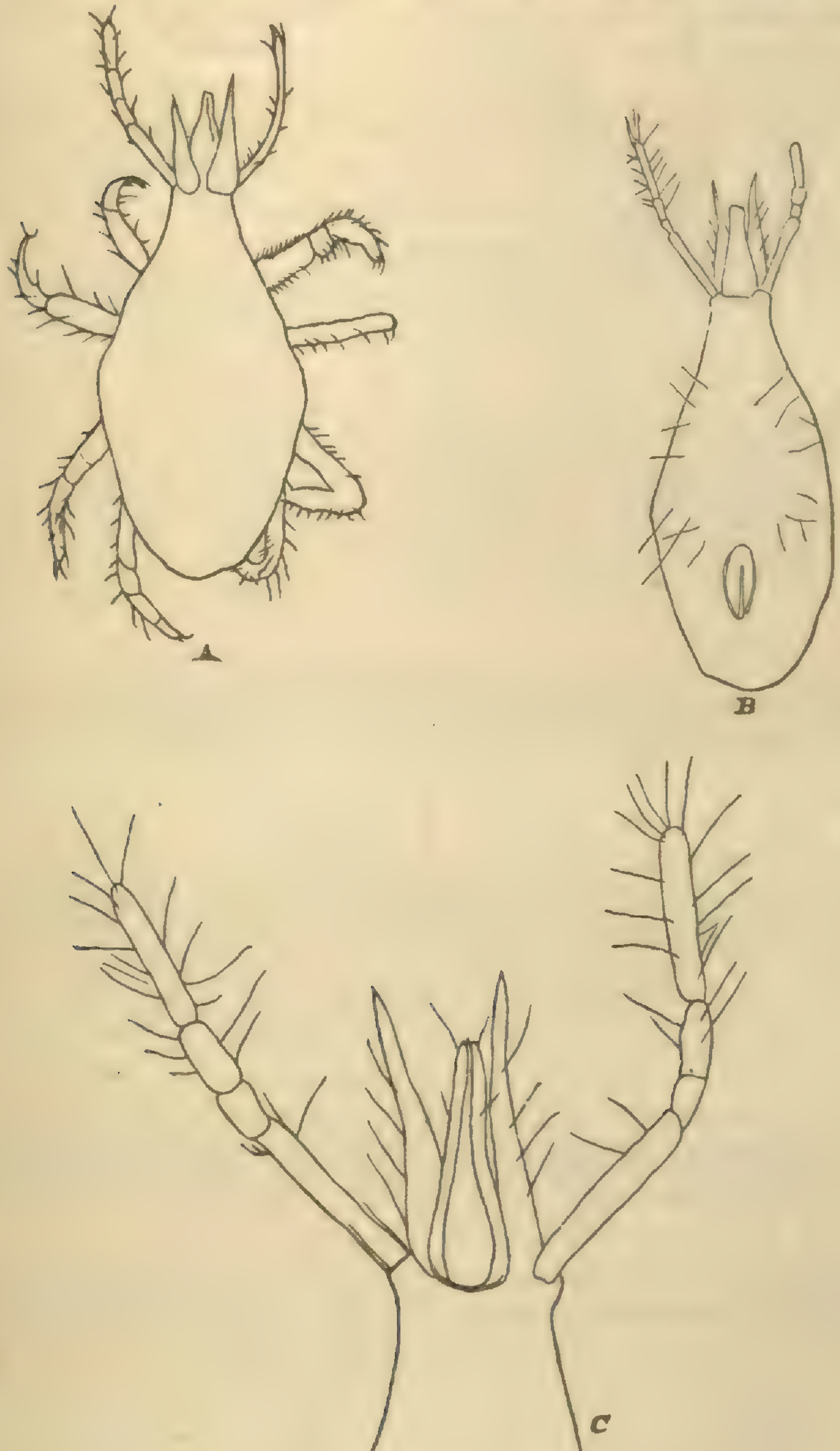


FIG. 2.—*Bdella marina* Pack.

When extended the prothoracic segment is considerably longer than the others. The head is one-third as large as the prothorax and a little more than half as wide. Length .35 inch.

I could not detect any spiracles on either of the thoracic seg-

ments. The tracheæ are not nearly so regular as in the larva of *Anthomyia ceparum*, by the side of which I placed it; though the present larva scarcely appears to belong to the Muscidæ, as there are minute antennæ present, there being no trace of them in the muscid larvæ as a rule.

As represented in the figure at *b*, dorsal view, and *d*, lateral view, two main tracheæ end each in a large dorsal tubercle, each with a tuft of fine respiratory setæ; the cleft ventral plate being fleshy at the tips. One of the respiratory tubercles is represented as seen from the side at *c*; it gives rise to a fan-like series of radiating fine setæ, which are directed upwards and a little forwards towards the base of the tubercle.

A new species of mite was also received from New Jersey through Professor Verrill, which was found living in the sea. It may receive the name of *Bdella marina* (Fig. 2: *A*, upper; *B*, under view; *C*, enlarged view of the proboscis and 2d pair of cephalic appendages, the so-called maxillæ).

The body is slender, pear-shaped; it is apparently eyeless, and the legs are no longer than the body is broad. The proboscis is long, conical; the maxillæ long and slender, acute; extending some distance beyond the end of the proboscis. The maxillary palpi are 4-jointed; the basal a third longer than the two following ones taken together, while the 4th (and last) is a little shorter than the basal joint. (The right palpus is not correctly engraved.) The description is drawn up from camera drawings, the specimen having been lost or mislaid. I cannot state the exact size or color of the animal. It was collected on the shore, but living immersed in the salt water, as I understand from Professor Verrill.—*A. S. Packard, Jr.*

Entomological Notes.—An extraordinary helix-like Psychid case, from East Africa, is reported and figured by Mr. R. McLachlan in the *Entomologists' Monthly Magazine* for June. The case is high and resembles shells of the genus Cyclostoma or Paludina in a wonderful degree. In some the spiral turns from left to right, in others from right to left. The texture is perfectly hard and firm, and somewhat fibrous.——The Bulletin of the Brooklyn Entomological Society, No. 2, is occupied by an essay preliminary to a monograph of the genus Catocala, by Rev. E. D. Hulst. It is illustrated by a plate of details of the external anatomy of these moths, especially the femoral spurs, claspers, and tarsal claws of different species. This society is doing useful work in publishing such synopses and monographs as already have and are promised to appear. We quite agree with Mr. Hulst in his remark that the genus Catocala occupies a position between the typical Noctuids and Geometrids, and that it ought to be placed closer to the first than it is, near Ypsia, Homoptera and its allies, and that these, "with Euclidia, ought to be almost

if not quite, at the end of the Noctuidæ."——Francis G. Sanborn, well known as a zealous and enthusiastic collector of insects, and a useful museum assistant, died suddenly June 5th, aged 46, while on a visit to Providence, at the house of George Hunt, Esq. He was one of the curators of the Natural History Society of Worcester. He was an amiable, generous man, and lepidopterists owe much to his willingness to communicate the rarities which he captured.——According to the researches of M. G. Carlet, the muscles of the abdomen of the bee are more numerous than they were supposed to be and, with the exception of the aliform muscles, which subserve circulation, are employed in respiration and consequently in calorification, which is important in the bee's economy. Thus the mechanism of respiration is more complicated than was before believed, since there is not only a lengthening and shortening of the abdomen, but an alternate approach and separation of its dorsal and ventral walls.——M. Ch. Brongniart, in his work upon the fossil insects of the coal beds of Commentry, describes a gigantic neuropter of the curious group of the Dictyoneura. This group contains insects which measure at least half a meter in length and 0.70$^{m.}$ or about two feet four inches in spread of wings.

ZOÖLOGY.

A new Infusorian belonging to the genus Vorticella.—The following heretofore undescribed infusorian occurs sparingly on the leaflets of Ceratophyllum in a pond near to, and often connected with, the Delaware river at Trenton, N. J.:

Vorticella lockwoodii, sp. nov.—Body when expanded broadly campanulate, not conspicuously changeable in form, the length about equaling the width, tapering posteriorly to the pedicel, and constricted beneath the border of the peristome, which is everted and equal in breadth to the entire length of the body; subspherical when contracted, and anteriorly crenulated; ciliary disc not elevated; cuticular surface bearing numerous scattered hemispherical or ovate elevations, diverse in size and usually collected about the equatorial region into irregularly disposed series, each prominence enclosing a nuclear nodule; parenchyma finely granular; contractile vesicles *two*, small, spherical, pulsating alternately; one placed somewhat above and in front of the other, near the pharyngeal passage; pedicel four to five times longer than the body. Length of the body and width of the expanded peristome field $\frac{1}{300}$ inch; width of the pedicel $\frac{1}{3000}$ inch. Habitat, pond water. Solitary or few together.

The characteristics by which this form may be readily distinguished from all Vorticellæ, are the existence and structure of the cuticular prominences and the undoubted presence of *two* contractile vesicles. The latter are in contour and position as stated above, but the writer would emphasize the fact of their duality. Hitherto no member of the genus has been observed with more than one pulsating vacuole, the latest generic diagnosis describing it as single without exception. The representation in the figure (Fig. 1, magnified 400 diameters) is somewhat diagrammatic, as both cannot be brought into focus at the same

time. When the circular outline of one is distinctly visible, the pulsations only of the other can be distinguished; with a homogeneous immersion 1/8 inch objective, however, and the one inch (C) ocular, giving an amplification of nearly a thousand diameters, the systole of each can be seen alternately by manipulating the fine adjustment screw during the diastole, or *vice versa*.

FIG. 1.—*Vorticella lockwoodii*, sp. nov. FIG. 2.—Cuticular elevations much enlarged.

The cuticular elevations are arranged in a series on the margin of the peristome border, but the nuclear bodies are there small and frequently obscure or absent. The prominences vary much in size even where most abundant. In contour they are generally hemispherical, but occasionally their outline is ovate, the two forms occurring on the same individual. The shape of the enclosed nucleus is uniformly the same in both, being that of a small circular disc, but that these internal bodies are disciform and not spherical, I have not been able to positively determine. They are, however, probably spherical.

The anterior and posterior regions of the body are, in some individuals, almost naked, while the cuticular prominences are usually more numerous centrally, with a tendency to collect into a more or less conspicuous equatorial zone. Some of the constituents of this belt, with their apparently disc-shaped nuclei, are shown greatly enlarged in Fig. 2.

It affords me much pleasure to dedicate this remarkable member of a remarkable genus to the Rev. Samuel Lockwood, Ph.D., an illustrious naturalist by whose friendship I am honored.—*Alfred C. Stokes, M.D.*

A NEW SPECIES OF INFUSORIAN.—In the Proceedings of the Canadian Institute, Vol. 1, Part 4, I described a Metopus occurring in water from a small pool in the neighborhood of Guelph, Canada, expressing an opinion that it constituted a new species, but refraining from naming it until I should have had an opportunity of examining other specimens. Lately I have found several examples in sediment from cistern water in the same city, the

study of which has convinced me of the correctness of my supposition.

Only one species of Metopus has hitherto been described, *M. sigmoides* Cl. & L., and under it Stein includes several varieties characterized by difference in form, but passing into each other by gradations, the same individual assuming different shapes at different periods of its existence, so that a mere difference in outline cannot be considered as a sufficient cause for the establishment of a new species. Stein describes three well-marked forms, the normal, the shortened and the rolled up. The individual described in the paper mentioned above was of the normal shape, those I have lately found may be described as belonging to the shortened type. The annexed figure represents one of them tolerably correctly.

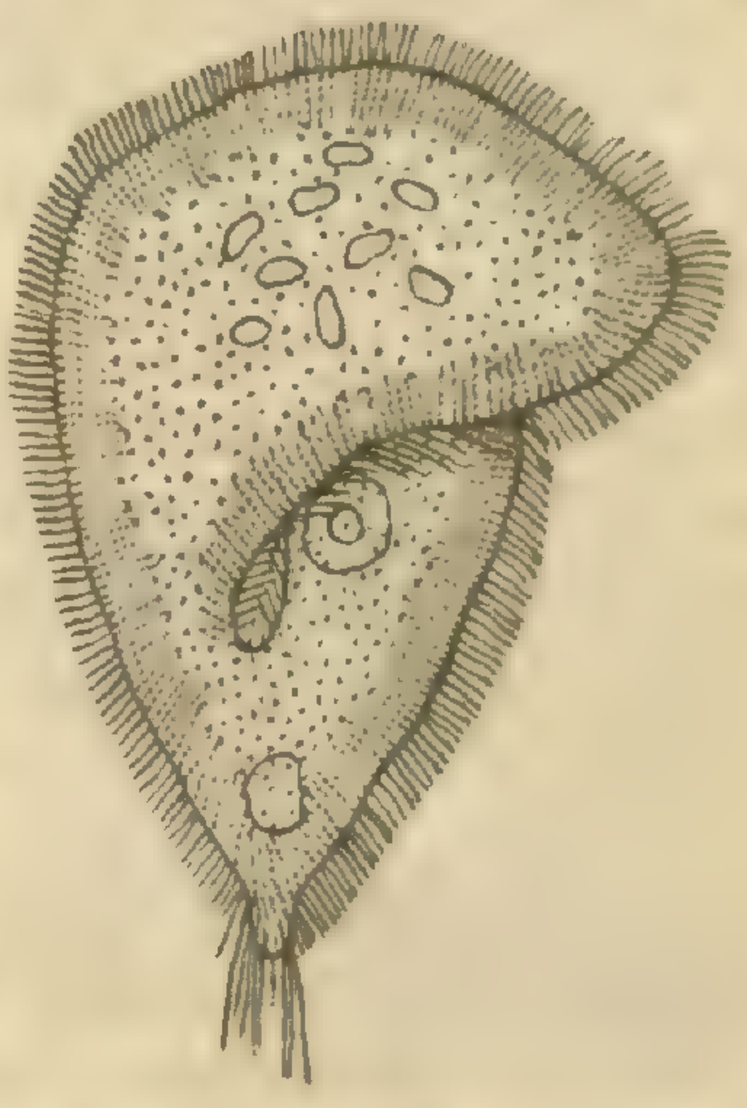


FIG. 1.—*Metopus striatus.*

They measured about .08$^{mm.}$ while the normal form was about double that, or .17$^{mm.}$ At first sight they recalled the form of a young Polygordius larva. The bent-over portion constitutes about one-half of the entire animal, and lies in a plane parallel to that of the posterior portion of the body which tapers somewhat suddenly posteriorly, so as to have a slightly pyriform outline. The axis of the bent-over portion, or "stirn-kuppe," is almost at right angles with that of the posterior portion. In the "stirn-kuppe" are a number of strongly refracting granules, as figured by Stein, and the body is terminated posteriorly by a bunch of bristle-like cilia.

The chief points wherein this shortened form differs from that described by Stein are as follows.

1st. The greater bending over of the anterior portion of the body, so that it is at right angles to the posterior portion.

2d. The greater breadth of the body in comparison to its length, and the abrupt tapering posteriorly.

3d. The striation of the border of the body.

In the description of the normal form I indicated the features in which it differs from Stein's; certain of these are still recognizable in the shortened form, others have disappeared, and others I did not have an opportunity of deciding upon. The plane of the bent-over portion in the normal form is at right angles to that of the posterior portion, in the shortened form it is parallel. The anal aperture I was not able to detect in the shortened form, but only one contractile vesicle, situated posteriorly, was present; the second anterior vesicle seen in a normal form was probably pathological, since it was not observed until after some days had elapsed since the animalcules had been placed in confinement be-

low the cover-glass. The striation of the border of the body was well marked in both forms, and was one of the most noticeable features. It has not been represented in any figures of *M. sigmoides*, and it may be concluded that it was absent, for if present it could not fail to have been delineated. On account of this peculiarity, present in both the forms, which resemble each other so slightly, but which are evidently the same species, I propose to name the form *M. striatus*. Although certain features characteristic of the normal form are thus absent from the shortened, still the normal form and that of *M. sigmoides* have very distinct differences, and so with the two shortened forms, and there is therefore a strong probability of the distinctness of the species.

I may mention here that for killing Infusoria, provided only a temporary preparation is required, I find a saturated solution of corrosive sublimate in water the most useful of any I have tried.[1] A drop or two run under the cover-glass produces almost instant death without any of the shrinkage so annoying even with osmic acid. After this treatment I find that staining with aniline blue, black or Bismarck brown takes place very rapidly and very satisfactorily.—*J. Playfair McMurrich, Agricultural College, Guelph, Canada.*

Life-history of the Hypopus stage of certain Mites.—From a careful series of experiments and observations, Mr. A. D. Michael, in a paper read to the Linnean Society of London, concludes that true "Hypopi" are not adult animals, but only a stage, or heteromorphous nymphs of Tyroglyphus and allied genera. Nor do all individuals become "Hypopi," which latter stage takes place during the second nymphal ecdysis. It seems a provision of nature for the distribution of the species irrespective of adverse conditions. "Hypopi" are not truly parasitic, nor do they confine themselves to any particular insect. A new adult form described is called by the author *Disparipes bombi*, and he believes there are other species of the genus. Donnadieu's bee-parasites are admitted to be adults, though it is uncertain if they are identical with Dufour's Trichodactylus.

Does the Crow Blackbird eat Crayfish?—In the Naturalist for November, 1881, this question is asked by Professor F. E. L. Beal, of the Iowa Agricultural College; in answer to it Mr. Charles Aldrich, in the January, '82, Naturalist, says it probably does, as he has seen a crayfish in the jaws of a blackbird. A few days ago, while investigating the food of some young blackbirds taken from a nest in an evergreen near the river, I found an abdomen of a crayfish in one of the stomachs, thus proving beyond all doubt that the young, at least, do eat crayfish.—*Clarence M. Weed, Mich. Agr. Col.*

[1] Meckel's fluid with acetic acid, as recommended by Brass, I have not yet tested.

Zoological Results of the Romanche expedition to Cape Horn.—Among the treasures gathered by this expedition and exhibited in the Palais de l'Industrie, are a skeleton of *Balænoptera sibbaldii*, another of *B. patachonica*, several of *Otaria jubata*, a single specimen of *Vespertilio chilensis*, several examples, some living, of the small domestic dog of the Fuegians, a *Lutra felina* and four species of Mus, two of which, *M. flavescens* and *M. xanthorhinus*, are rare. Out of 477 examples of Aves only forty species are terrestrial. Among the penguins *Microdyptes serresiana* has hitherto been known from a single specimen only. Among the fishes *Lycodes obscurus*, a species related to Cyclopterus, and the genus Lepidochnictys are new. Fresh-water fishes are represented by *Galaxias maculatus* and *Notothenia tessellata*. The predominating genera of mollusks are Oscabrion, Patella and Mytilus. All the large species are edible. The large mussel shells, fixed upon a stone handle, are used by the Fuegians as knives.

Among the mollusks are Chitons, Volutes, Succineas and Chilias, many of them new, but there are no fresh-water shells, and only three or four small Helices. Echini, which are a valued article of food to the Fuegians in July and August (the end of winter) are abundant, and the starfishes include *Labidiaster radiosus*, which has evident relations to Brisinga, and *Ctenodiscus australis*. The collection of insects is not only interesting on account of the new species, but because of numerous forms which were previously known only from parts of South America near the equator.

Zoological Notes.—*Sponges.*—The *Challenger* report upon the calcareous sponges is the work of Mr. A. Polejaeff, of Gratz. Thirty species were recognized, twenty-three of which are new. The author places the sponges among the Cœlenterata as a subclass, of which the group of calcareous sponges constitutes the two orders of Homocœla (Asconidæ) and Heterocœla, with the three families Syconidæ, Leuconidæ and Teichonidæ.

Cœlenterates.—H. W. Conn and H. G. Beyer (Stud. from the Biol. Lab. J. Hopk. Univ., 1883), describe the various nerve structures of Porpita. These consist of nerve ganglion cells, about $\frac{1}{2000}$ of an inch in diameter, usually tripolar, but sometimes bipolar, with a thread-like process from each pole; and of some hundreds of small ectodermal pockets arranged around the edge of the velum. These pockets are formed of much enlarged ectodermal cells, some of which have a distinct nucleus and nucleolus. They would seem to be organs of touch.

Mollusks.—By far the greater part, if not the whole, of the primitive kidneys of Helix have been ascertained by M.P. de Meuron to be of ectodermal origin. The walls of these organs have all the characters of regular epithelium, there is a wide external opening,

and M. de Meuron is convinced of the existence of an internal orifice furnished with vibratile cilia directed backwards. The true kidneys in the same genus are composed partly of an ectodermal invagination, and partly of mesodermal structure. The two parts unite early and so closely that they cannot be distinguished. The kidney then increases rapidly and takes the shape of the letter S, one extremity terminating at the bottom of a fold of the pallial cavity, while the other opens into that of the pericardium. M. Grobben considers the cavity of the pericardium as the remains of the primitive cœloma, but M. de Meuron sees in it the cavity of the posterior of the two somites of a mollusk. The primitive kidneys thus represent the excretory organ of the first somite; and the true kidneys that of the second somite.——Professor H. L. Osborn (Stud. from the Biol. Lab. J. Hopk. Univ.), gives an account of his studies upon the structure and growth of the shell of the oyster. A thin circular glass was inserted between the outside of the mantle and the inside of the shell, and the secretion examined. After twenty-four hours a thin gummy deposit, with in some cases a few lime crystals, was found. This was clearly a viscid secretion from the surface cells of the mantle. In a second twenty-four hours the glass was enveloped in a leathery brown membrane, like the epidermis of a shell, but containing calcium carbonate in solution. A film six days old had lost its leathery character and become strong, and after three or four weeks the glass is completely coated with white shell, principally formed of the mother-of-pearl layer.

Crustaceans.—The *Challenger* report upon the Cirripedia is by Dr. P. P. C. Hoek. Seventy-eight species are represented, only nineteen of which were previously known. Of the thirty-four genera of Cirripedia now known, twenty-eight have not been found below 150 fathoms; two occur from the shore to 400 fathoms, Balanus reaches to 510 fathoms, Dichelaspis to 1000, and Scalpellum and Verruca have been observed below 1000 fathoms. Forty species of Scalpellum were added by the *Challenger* to the eleven before known. As with fossil Scalpelli, the species are numerous, the individuals rare. Ten species of Verruca were found, six of them new. The distribution of this genus is world-wide, and the six new species inhabit depths of from 500 to 1900 fathoms.——The *Challenger* report of Dr. G. S. Brady on the Copepoda contains descriptions of 106 species, including eleven new genera. The specimens were almost entirely taken with a surface net. From the equator to the poles it seems certain that the ocean supports everywhere an abundance of Entomostraca, chiefly Copepoda, and the cold waters of the polar regions seem even more favorable to these animals than the tropics. The species, as a rule, have a wide distribution, but some, as *Calanus finmarchicus*, seem to be arctic, while others, as *Undina darwinii* and *Euchæta prestandreæ* belong to warmer seas. The only

undoubted deep-sea species is *Pontostratiotes abyssicola*, dredged in 2200 fathoms. This was previously described in MS. by Dr. von Willemoes Suhm as *Lernæa abyssicola* and was found on *Ceratias uranoscopus* dredged in 2400 fathoms.

Tunicates.—M. L. Roule has studied the genus Rhopalea, an ascidian abundant near Marseilles at a depth of fifty to sixty meters. Rhopalea does not reproduce by budding, and may be considered as forming a link between the simple and the compound tunicates.

Batrachians.—M. G. Calmels finds in the poison of batrachians a small portion of methylcarbylamine, which gives to the liquid some of its odor and toxic qualities; it also contains, in larger quantities, an acid from which the methylcarbylamine is formed.

Birds.—Herr Stieneger informs *Naturen* that Kamtschatka has four species of sea-eagle, *Haliaëtus hypoleucus*, *H. albicilla*, *H. leucocephalus*, and *Thalassaëtus pelagicus*. The first of these is distinguished from the others by the dazzling whiteness of some parts of the body and by its generally lighter color. Among the cetacean crania collected, three seem to belong to a new species.

Mammals.—Dr. P. Albrecht, in a communication to the Anthropological Society of Brussels, maintains that there are primitively four intermaxillaries, and that hare-lip, which is never central, takes place by the separation of the inner and outer intermaxillaries of one or the other side. As proof of this, he figures cases of double hare-lip, in which the two inner bones (endognathia) stand out as a separate bone anchylosed in the median line, while each outer intermaxillary, bearing its incisor, is united to the maxillary. In the Ornithorhynchus, as figured in a communication of the same observer to the Pathological Society of Brussels, the two outer intermaxillaries (mesognathia) are large and widely separated, while between them, but further back, is a single bone, which is by M. Albrecht homologized with the endognathia. On each side of this is an incisive canal. Behind the mesognathia are two large submaxillaries or exognathia.

PHYSIOLOGY.[1]

Connection between Physiological Action and Chemical Constitution of Drugs.—Dr. Blake states very confidently that a physiological classification may be made of chemical substances according to their isomorphism and atomic weights. Isomorphous substances, regardless of chemical composition, have the same general physiological action. He found, moreover, "that amongst the salts of the metallic elements the intensity of their physiological action was connected with the atomic weight of the element, so that when the elements are arranged in isomorphous

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

groups, the action of substances in the same isomorphous group is a function of the atomic weight, the greater the atomic weight the smaller the quantity required to produce the same physiological action." The author divides the chemical elements into ten groups, in each of which, among the metals, with one exception, the salts are isomorphous and have characteristic physiological actions which are described in detail.—*Jl. of Physiology, Vol.* v, *No.* 1.

THE ACCELERATOR AND INHIBITORY NERVES OF THE HEART OF COLD-BLOODED ANIMALS.—The heart of the frog is connected with the central nervous system only through branches of the vagus nerves, while in the higher animals the heart is separately supplied by the vagus and fibers from the ganglia of the sympathetic system. When the sympathetic branches are cut and their peripheral or heart ends are stimulated, the rate of heart-beat is quickened. But the reverse effect follows when either vagus nerve is treated in the same way; the heart-beat in this case being retarded or stopped. It is accordingly believed that the sympathetic heart-nerves are efferent accelerator nerves, while the fibers of the vagus have a cardio-inhibitory function. But in the case of the frog Gaskell finds that stimulation of the vagus, which is the only heart-nerve, may: "1. Slow or accelerate the rate of the beat; 2. Diminish or augment the force of the contractions both of auricle and ventricle; 3. Lessen or increase the excitability of the cardiac muscle; 4. Diminish or improve the conduction power of the muscular tissue. Such opposing effects are evidently due to one of two causes, either (1) to the joint stimulation of nerves belonging to two separate nerve systems of which the one system contains purely inhibitory and the other purely augmentor (accelerator) fibers; or else (2) to the stimulation of nerves which are able sometimes to augment, sometimes to inhibit the cardiac functions according to varying conditions of the nerves or of the heart itself. In order to decide between these two hypotheses, it seemed to me advisable to find a cold-blooded animal possessing definite accelerator nerves, so as to see whether the sympathetic system provided the heart entirely with augmentor fibers while the vagus contained only inhibitory. For this purpose I selected the crocodile as being the most likely of all cold-blooded animals to possess a nervous system closely resembling that of the warm-blooded. My expectations were fully answered; the accelerator nerves of the crocodile leave the main sympathetic chain at a large ganglion corresponding apparently to the ganglion stellatum of warm-blooded animals, and accompany the vertebral artery up to the superior vena cava, where they leave the artery and passing alongside the vein anastomose with branches of the vagus in the neighborhood of the heart. Stimulation of these nerves increases the rate of the car-

diac rhythm and augments the force of the auricular contractions, while stimulation of the vagus slows the rhythm and diminishes the strength of the auricular contractions."

Guided by these facts the author was successfully led to attempt to isolate the sympathetic nerve twigs which join the cranial vagus in the frog near its exit from the skull, and the following are the physiological results obtained:

"Stimulation of the sympathetic before its entrance into the combined ganglion of the sympathetic and vagus, produces purely augmentor (accelerator) effects. Stimulation of the vagus within the cranial cavity before its entrance into the ganglion, produces purely inhibitory effects."

The communication is of special value in removing a doubt as to whether the action of individual nerves is physiologically invariable or capable of being altered under changed conditions. —*Jl. Physiology, Vol.* v, *No.* 1.

The time taken by the Blood in making the circuit of the Body.—Dr. Smith, in describing a new method for determining the velocity of the blood current, calls attention to the inaccuracy of the old experiments by which it was sought to find the rate of circulation by measuring the time elapsing between the injection of an iron salt into one jugular vein and its appearance in the jugular on the other side of the neck. Various chemical substances in solution make this circuit in very different periods, because, apparently, of their different diffusibility. According to the method now considered, de-fibrinated pigeon's blood is injected into one jugular vein of an animal whose blood is allowed to drop from the other jugular into a series of watch-glasses placed in a circle upon a table which is revolved by clock-work. Microscopic examination of the blood thus collected is made to determine in which watch-glass the oval corpuscles of the pigeon's blood first appear; then knowing the rate at which the table is turned it is easy to estimate the time taken by the pigeon's blood in passing from one jugular to the other, in which passage it has probably traversed not only the heart and lungs, but the capillaries of the head as well. The mean of six experiments gives the time of circulation in the dog as 17.5 seconds, during which the heart made 51.5 pulsations. In the rabbit the time of circulation was 11 seconds, during which there were 31 heart-beats. When solid particles are injected into a moving current, as the blood, the heavier ones are carried at a faster rate than the lighter, because the former are more readily drawn into the swiftly moving axial current. Thus in the living blood-vessels, the heavier red corpuscles are confined to the central core or axial current, while the lighter leucocytes occur chiefly in the outer "inert" layer. The author finds that very finely divided carmine particles suspended in a fluid require twice as long to

pass from one jugular to the other as do the corpuscles of pigeon's blood, and the mean velocity of the current lies somewhere between the two rates determined.—*Am. Jl. Med. Sci., No.* CLXXIV.

PSYCHOLOGY.

THE NATURE OF INSTINCT.—This subject has lately been discussed by Messrs. Romanes and C. Lloyd Morgan. As to the view that there is a science of comparative psychology as held by Romanes and others, Mr. Morgan inquires, in *Nature* for Feb. 14, (1) Whether there is a science of comparative psychology; (2) discusses the place of consciousness; (3) the lapse of consciousness; (4) a psychological definition of instinct; (5) a physiological definition of instinct; (6) the origin and development of instinct. Mr. Morgan thus concludes:

1. While fully admitting the great interest that attaches to the study of the inferred mental faculties of the higher brutes, I believe that, from the ejective nature of the animal mind and the necessary absence of verification, no science of comparative psychology, except such as is restricted to "objective psychology," is possible.

2. Of the four views of the place of consciousness in the animal world, only one—that of *free will*—renders the study of the actions of animals incapable of scientific treatment. Of the other three I believe *determinism* to be the most satisfactory. According to this view both neuroses and psychoses are subject to law. But from our necessarily ejective knowledge of psychoses, we are forced to confine our attention (from the scientific point of view) to the objective phenomena of neurosis, especially as manifested in conduct; of the psychoses, we can know nothing with certainty; of the neuroses we may learn a little; of conduct we may learn much.

3. From the principle of the lapse of consciousness certain corollaries may be drawn: (*a*) That it is difficult or impossible to say what amount of consciousness, if any, an action performed by my neighbor involves; (*b*) that it would seem probable that the lapse of consciousness in the individual is paralleled by a lapse of consciousness in the species; and (*c*) that the hypothesis that instinctive actions are unconscious is incapable of disproof.

4. On the general ground given in 1, and on the special ground given in 3, I see great difficulties in accepting the psychological theory of instinct—that instinct is reflex action into which is imported the element of consciousness.

5. In accordance with the principle thus advocated, a physiological definition of instinct must be sought. Some such definition as this may be proposed: *Instinctive actions* are actions performed by the individual in virtue of his possession of a special

type of nervous organization, that is, a type of organization common to his species.

6. The question of the origin and development of instincts thus becomes a question as to how this special type of structure has been evolved. It takes its place as part of the general question of the evolution of structures—the actions being the external manifestations of internal structures. To the question as to the relative importance of direct and indirect equilibration I could give no definite answer within the limits of this article, and therefore gave quotations from Darwin and Herbert Spencer.

INTELLIGENCE IN THE BEAR.—*Nature* contains the following anecdote, contributed by J. M. Hayward, of a bear in Russia: "The following was narrated to me by Mohl's brother, on whose estate it took place. The carcass of a cow was laid out in the woods to attract the wolves, and a spring trap was set. Next morning the forester found there the track of a bear instead of a wolf on the snow; the trap was thrown to some distance. Evidently the bear had put his paw in the trap and had managed to jerk it off. The next night the forester hid himself within shot of the carcass to watch for the bear. The bear came, but first pulled down a stack of firewood cut into seven-foot lengths, selected a piece to his mind, and taking it up in his arms, walked on his hind legs to the carcass. He then beat about in the snow all round the carcass with the log of wood before he began his meal. The forester put a ball in his head, which I almost regret, as such a sensible brute deserved to live."

ANTHROPOLOGY.[1]

UNIFORM CRANIOMETRY.—In September, 1877, a craniometric conference was held in Munich (*Correspondenzblatt*, 1878, No. 7), and a second conference in August, 1880, in Berlin (*Correspondenzblatt*, Bericht uber die XI., Allg. Versamml., pp. 104–106). At the thirteenth general meeting at Frankfort, August, 1882, a perfected scheme was proposed. This is published in *Archiv für Anthropologie*, XV, pp. 1–8, 1884, and signed by sixty-seven of the most eminent anthropologists in Germany, Switzerland, Austria, Italy and Russia.

The Horizontal.—The line selected for the horizontal of the skull is that extending from the lower edge of the orbital cavity to the middle of the ear cavity or the upper edge of the internal *meatus*.

The linear measures of the cranium are 16; of the face, 15. The capacity of the skull is taken with shot, if possible. The cranial indices are as follows:

Dolichocephaly	.75 and under.
Mesocephaly	.751–.799.
Brachycephaly	.80–.85
Hyperbrachycephaly	.851 and over.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Chamæcephaly	.70 and under.
Orthocephaly	.701–75
Hypsicephaly	.751 and over.
Prognathy	to 82°
Mesognathy or orthognathy	83°–90°
Hyperorthognathy	91° and over.

Other indices are based on the height of the face, orbital cavity, nasal cavity, and palate.

The following table is drawn up for the purpose of indicating the manner of reporting measurements:

		Number	
		Source	
		Sex	
		Age	
	C	Capacity	Cranium
	L	Length	
	B	Width	
	B^1	Width of forehead	
	H	Height	
	OH	Height of ear	
	LB	Length of skull base	
	N	Horizontal circumference	
	S	Sagittal circumference	
	Q	Lateral circumference	
	GH	Height of face	Face
	G^1H	Height of upper face	
	GB	Width of face	
	J	Zygomatic width	
	NH	Height of nasal cavity	
	NB	Width of nasal cavity	
	O_1	Width of orbit	
	O_2	Height of orbit	
	G_1	Length or palate	
	G_2	Width of palate	
	PL	Facial angle	
	L : B	Length and height	Indices
	L : H	Length and height index	
	B : H	Breadth and height index	
	GH : GB	Face	
	G^1H : GB	Upper face	
	NH-NB	Nose	
	O_1 : O_2	Orbital cavity	
	G_1 : G_2	Palate	
		Remarks	

Ethnology of British Guiana.—On the 1st of June, 1882, appeared the first number of a semi-annual journal, published in Demerara, bearing the following title: *Timehri:* being the journal of the Royal Agricultural and Commercial Society of British Guiana. Vol. 1, Pt. 1, June. Edited by E. F. im Thurn, and published by J. Thomson. The fifth number has recently been published, bringing the journal up to date. Mr. im Thurn also published, in 1883, "Among the Indians of Guiana," being sketches

chiefly anthropologic, from the interior of British Guiana, with fifty-three illustrations and a map. London, Kegan Paul, French & Co., pp. 445, 53 ill., map. Let us look first at *Timehri.* The word *Timehri* or *Timeneeri* is Carib for certain marks on rocks, corresponding to our pictographs, found throughout Guiana. The papers containing ethnologic matter will be given by title:

E. F. im Thurn. Tame animals among the Red men of America (I, 25). [The Indians of Guiana find means to tame nearly all the wild animals of the country, not for love of pets, but to increase their wealth. They even know how to change the color of parrots from green to yellow. At one house the writer saw parrots, macaws, trumpet birds, troupials, monkeys, toucans, curassow birds, a sun bird and many others. Monkeys are abundant in some settlements, deer of two sorts are sometimes tamed, as well as peccaries, quashies, jaguars, tapirs, labbas, water-hogs, acouries, ducks, troupials, bell-birds, hawks, owls, herons, plovers, cock-of-the-rock and iguanas.]

West Indian Folk-lore, I, 145.

E. F. im Thurn. Notes on West Indian stone implements, I, 257–271, II, 252–264 [The implements described are polished celts, large ornamented axes and mammiform stones.]

The Di-di or water mamma, I, 298.

Indian privileges, I, 306.

Couvade, I, 310–314; II, 159, 355.

Jonah myths, II, 161.

Local medicinal barks, II, 348.

Still more interesting is the volume by Mr. im Thurn entitled "Among the Indians of Guiana." The first five chapters (p. 1–155) relate chiefly to the geography and natural productions. The rest of the volume describes minutely the tribes, marriage systems, dress, houses, social life, arts, feasts, religion and antiquities.

The following tribal names occur:

	Branch or Stock.
Ackawoi	Carib.
Amaripas	Wapiana.
Arawaks	Arawak.
Arecuna, Arecuma	Carib.
Atarois	Wapiana.
Caribisi, Caribs	same — Carib.
Carinya, Caribs call themselves (people).	
Cobrungrus, hybrids between Indians and Negroes.	
Daurais, same as Atarois.	
Engaricos, hybrids between Macusis and Arecunas.	
Kapohn, Ackawois call themselves (people).	
Lokono, Arawaks call themselves (people).	
Macusi	Carib.
Maiongkongs, beyond the British border.	
Maopityans, unclassed.	
Nikarikarus, hybrids between Macusis and Brazilians.	
Paramona, Partamona	same, sub-tribe of Ackawoi — Carib.
Pianoghotto, sub-tribe of Macusi	Carib.
Piriana, beyond the British border.	
Pshavaco, hybrids.	
Taruma, common vocabulary with Moapityans.	
Taurais, same as Atarois.	

	Branch or Stock.
Waccawai, same as Ackawoi.	
Wapiana	Wapiana,
Warrau	Warrau.
Woruma, hybrids.	
Woyowai, only the name is known.	
Zurumutas, sub-tribe of Macusi	Carib.

To give a faint conception of the rich veins of ethnologic lore in this volume it would be necessary to quote many pages. We have so few collaborators in South America, that Mr. im Thurn is to be congratulated for his energy and wise use of his time.

THE CATLIN COLLECTION.—The editor of these notes had the painful pleasure of unpacking the last of George Catlin's magnificent collection a few days ago. Among a multitude of articles of dress, industry and ornament, many are in good state of preservation, having the merit of being collected forty years ago and taken from the hands of those who made and used them. But, sad to tell, time, neglect and insects have played dreadful havoc with many beautiful and rare things. It was hard to realize that so few years could work such changes, yet such is the case, and many more fine collections will go the same path.

MICROSCOPY AND HISTOLOGY.[1]

METHODS OF IMBEDDING.[2]—Dr. Blochmann reviews the various methods of imbedding, describing in detail those that have come into general use, and pointing out the advantages and disadvantages of each.

In every method of imbedding the principle is the same, namely, to saturate objects with substances which not only fill out the larger internal cavities, but which also penetrate the tissues themselves, rendering them (after cooling) sufficiently hard for the process of sectioning.

Glycerine and Gelatine.—

Gelatine	1 part.
Distilled water	6 parts.
Glycerine	7 parts.

For preservation a little carbolic acid (1 gram for 100 grams of the mixture) should be added. Objects are transferred directly from water to the melted mixture; and, after complete saturation, imbedded in paper boxes. After cooling the objects thus imbedded are hardened in alcohol, then sectioned and mounted in glycerine.[3]

Schiefferdecker's method of imbedding in Celloidine.[4]—Celloidine

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] F. Blochmann. "Ueber Einbettungsmethoden." *Zeitschr. f. wiss. Mikr.*, I, H. 2, p. 218, 1884.

[3] This method is recommended by Kaiser. Botan. Centralbl., 1 p. 25, 1880.

[4] Arch. f. Anat. u. Phys., 1 Abth., p. 199, 1882.

is prepared in plates, and may be obtained from Wittich & Benkendorf, Chaussee Strasse 19, Berlin N.

Schiefferdecker uses two solutions, one of a syrupy consistency, the other somewhat thinner. The celloidine plate is cut into small pieces and dissolved in absolute alcohol and ether (in equal parts). Objects are transferred from absolute alcohol,[1] first to the thinner solution, then to the thicker. After remaining a few hours (or days, according to the character of the object) in the latter they are imbedded in paper boxes. As soon as a hardened film forms on the solution in the box, the whole is placed in 82 per cent alcohol for 24–48 hours, and thus rendered sufficiently hard for cutting.

Blochmann recommends imbedding on a cork rather than in a paper box, as less celloidine is required, and as the cork is held more firmly in the holder. One end of the cork is made rough and surrounded by a strip of paper, which is made fast by a pin, as shown in the figure. The roughened surface of the cork is wet with absolute alcohol and then the object imbedded in the usual manner. In order that this small box may sink in alcohol, in which it is placed for hardening the celloidine, it may be weighted with a small lead ball fastened to the cork by a needle (see figure).

In cutting, the knife is kept wet with alcohol (70 per cent). The sections may be placed in water or in alcohol, and afterwards stained with carmine or hæmatoxylin, in which the celloidine is only a little or not at all, stained. Aniline dyes color the celloidine, and therefore should not be used.

The sections can be mounted in glycerine or in balsam; but in the latter case they must be anhydrated with 95 per cent alcohol, as absolute alcohol dissolves the celloidine. They should be clarified in bergamot oil or origanum oil (clove oil dissolves the celloidine).

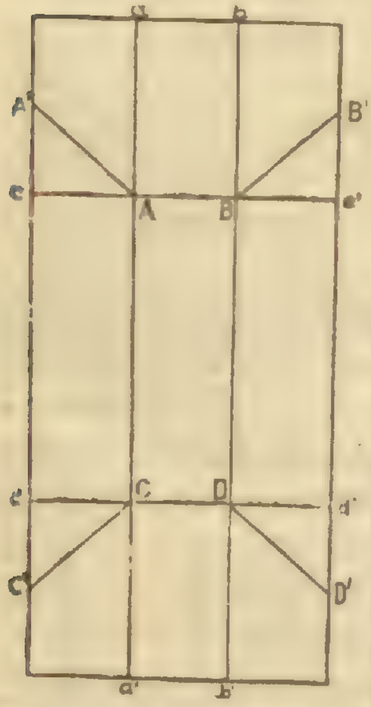
Objects imbedded in celloidine can be preserved, ready for cutting, for a long time in 70–80 per cent alcohol.

Imbedding in Paraffine.—The object is transferred from absolute alcohol to chloroform, and left till the alcohol has been entirely replaced; it is next placed in a shallow vessel with a small quantity of chloroform, and enough paraffine added, in fine pieces, to cover it after the chloroform has evaporated. The vessel is then exposed to a temperature which corresponds to the melting point of the paraffine employed. The paraffine melts and the chloroform evaporates, so that the object is brought very gradually into pure melted paraffine. In this way the object becomes *completely* saturated with the paraffine.

[1] If the objects are penetrated with difficulty, they may be transferred from absolute alcohol to ether, then to the celloidine solutions.

It is essential that the mixture be kept at the proper temperature until *all* the chloroform has evaporated. A simple test is to place a hot wire in the paraffine, if no bubbles arise, it is safe to conclude that the chloroform has entirely escaped.

After evaporation of the chloroform, the object may be placed in any desired position, and the paraffine allowed to cool. After cooling the object can be cut out and fixed to a larger block of paraffine fitted for the holder of the microtome.



Boxes for imbedding may be made of rectangular pieces of paper of the thickness of postal cards in the following manner: The paper is first broken in the lines *a a'* and *b b'*, then *c c'* and *d d'* (by bending always towards the same side). Then in every corner a break (*A A'*, *B B'*, *C C'*, *D D'*) is made by bringing *A c* and *A a* together. The four sides of the box are next bent up and the corners at the same time turned outward and back behind the ends *A B a b* and *C D a' b'*. Finally the upper edge of these ends is bent down over the corners.

Bubbles around the object may be removed by means of a heated wire.

A Simple Section-Smoother.[1]—Led by a suggestion of P. Francotte, the writer devised a simple form of section-smoother which can readily be made by any one and which fairly answers the purpose for which is was intended. A piece of iron wire is bent in the manner shown in the cut, so that the two ends will form a spring clip grasping the back of the knife. The middle portion is so fixed that it will be parallel with the edge of the knife and at a distance of about a hundredth of an inch from it. For this purpose the writer has found an ordinary hairpin, deprived of its lacquer, about the right size.

In cutting, the section passes between the wire and the blade and all tendency to curl is prevented. This form of smoother is applicable to the knife when used in any form of sledge microtome, or when cutting free-hand; but for use with the Sterling (well) microtome it is evidently ill adapted, for the ends which come underneath the blade would interfere with the work. The form of smoother recently described by Drs. Gage and Smith embraces the same principle but is more complicated.

[1] J. S. Kingsley, Science Record, II, No. 5, p. 112, March 15, 1884.

ON THE USE OF VASELINE TO PREVENT THE LOSS OF ALCOHOL FROM SPECIMEN JARS.[1]—The petroleum preparation known as vaseline is known to be practically unaffected by ordinary temperatures and by most substances. In the Journal of the Chemical Society, July, 1882, p. 786, it is said to be "sparingly soluble in cold strong alcohol, and completely in hot, but separates out on cooling." After trying various substances, wax, paraffine, oil and glycerine with but partial success, the use of vaseline was suggested by the two authors independently and nearly at the same time. The experiments tried this spring indicate that, during three months, at ordinary spring and summer temperatures, there is no appreciable loss of ninety-five per cent alcohol from glass vials or jars, whether upright or inverted or on the side, provided corks are anointed on the bottom as well as on the side, provided ground glass stoppers are anointed and firmly inserted, and provided the rubber rings of fruit jars and the specimen jars made by Whitall, Tatum & Co., are anointed on both sides and the covers well screwed down.

We have also used the vaseline for preventing the loss of other liquids, excepting chloroform and spirits of turpentine; as a lubricator of drawers, and to prevent the sticking of the covers or stoppers of cement vials; and for the prevention of rust upon steel instruments.

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SCIENTIFIC NEWS.

— Prizes given by the French Academy (continued from p. 752, July No.).—The grand prize in geology was given to M. Fontannes for his studies of the Tertiary basin of the south-east of France, carried on by him with great ardor for ten years. Thanks to him the newer formations of the valley of the Rhone are now among the best known regions.

A second prize of 2000 francs fell to M. Peron for his "Geological Description of Algiers."

The "Prix Barbier," for an important discovery in surgical, medical or pharmaceutical science, was allotted to M. J. Chatin for his researches upon the trichina. His work is a complete monograph, reviewing all previous published works upon the worm and adding many new facts.

In botany the "Prix Desmazieres" was awarded to the memoir of MM. G. Bonnier and L. Mangin, entitled "Researches on the respiration and transpiration of Fungi." This work marks a great advance both in the special physiology of fungi and in general physiology.

An "encouragement" of 500 francs was accorded to M. Klein for his memoirs on "Vampyrella" (which he places near the Myxomycetes) and on the "Crystalloids of marine Algæ."

[1] Wilder and Gage. Proc. A. A. A. S., XXXII, p. 318.

The Fons-Melicocq prize for the best work upon the botany of the north of France, was not awarded, but an "encouragement" was given to M. Ch. Magnier for the ensemble of his works.

The "Prix Bordin" for the best work upon the influence of the environment upon the vegetative organs; the changes undergone by terrestrial plants when grown in water, and by aquatic plants grown in air; and the causes, as ascertained by direct experiment, of the special forms of some species of the maritime flora, was allotted to M. Costantin, whose memoir, the result of three years of labor, contributes largely to the development of experimental anatomy. Two other anonymous works were submitted, and to the one of these bearing the motto, "Hoc opus, hic labor est," a prize of 1000 francs was given.

The "Prix Morogues," to be given every decade for the work which during that term may have been most beneficial to the progress of agriculture in France, was awarded to the "Biological Chemistry" of M. Duclaux, forming part of the "Chemical Encyclopædia" published by M. Fremy. In giving this award especial notice was taken of the author's researches upon milk, without losing sight of the fact that his labors were carried into almost all agricultural industries.

For the "Grand Prix" in anatomy and zoölogy, to be given to the best memoir upon the histological development of insects during their metamorphosis, M. Viallanes was the only applicant, but his work was of such excellence that the prize was unanimously decreed to be his.

The "Prix Bordin," for researches in botanical or zoölogical palæontology in France or Algiers, was awarded to M. Grand-Eury, for his two works entitled, "The Carboniferous Flora of the department of the Loire and the center of France," and "On the formation of Coal."

The "Prix Savigny," for young traveling naturalists, was not given, neither was the "Prix Thore."

The Montyon prizes in medicine and surgery were three, each of the value of 2500 francs, and were decreed to Dr. Constantin Paul for his treatise upon "The diagnosis and treatment of diseases of the Heart;" to Dr. H. Roger for his "Clinical researches upon the diseases of Infancy;" and to Dr. E. Vallin for his treatise on "Disinfectants and Disinfection."

Prizes of 1500 francs were given to Doctors H. Napias and A. J. Martin for their treatise upon "The study and progress of hygiene in France;" to Doctors L. Dubar and Ch. Remy for their memoir on "Absorption by the Peritoneum;" and to the "Treatise upon Uterine Inversion" of Dr. P. Denuce. Honorable mention was given to six other works.

The Breant prize was awarded to Dr. Fauvel for his work upon the etiology and prophylaxy of cholera, a continuation of the labors which gained him the same prize in 1870. The sum of

10,000 francs was divided among the four pupils of Pasteur, M. Strauss, Roux, Nocard and Thuillier, who composed the commission which in the past year studied the cholera on the spot in Egypt. The last gentleman fell a victim to his devotion to science and humanity.

The "Prix Godard" was decreed to Dr. Guelliot for his monograph on the "Anatomy, Physiology and Pathology of the Vesiculæ Seminales." Honorable mention was made of the work of Dr. Desnos on lithotrity.

The "Prix Chaussier" was given to Dr. Legrand du Saulle for his "Medico-legal studies of epileptic and hysterical subjects." These four volumes, both in France and abroad, are constantly cited as authority upon the legal aspects of emotional insanity.

Honorable mention was made of the remarkable work of M. A. Layet on the "Hygiene and maladies of the Peasantry" and to M. A. Luton for his work on special and general therapeutics.

The "Prix Lallemand" was not awarded, but its value was divided between M. B. Ball, author of "Lessons on Mental Diseases," and M. Aug. Voisin for his "Clinical lessons on mental and nervous Maladies."

The Montyon prize in physiology was awarded to Dr. P. Reyard for his experimental researches on the pathological variations in respiratory combustion; and the "Prix Lacaze" was given to M. Balbiani for the total of his works upon embryogeny and general physiology during the last twenty years.

The "Prix Penaud," for ærostation, was parted into three equal portions, and given to MM. Gaston Tissandier, Duroy de Bruignac and V. Tatin.

Among the general prizes the "Prix Tremont" was decreed to M. J. Morin for his mechanical inventions; the Gegner prize was divided between MM. Ed. Lescarbault and Ch. Brame; the "Prix Petit d'Ormoy" (mathematical sciences) was given to M. Gaston Darboux; the "Prix Petit d'Ormoy" (natural sciences) was unanimously awarded to M. Henri Filhol for his researches among the Tertiary mammals of France; and medals of honor from the Petit d'Ormoy funds were given to the various members of the *Talisman* exploring expedition, and to those who, in 1883, formed part of the French expedition to Cape Horn in the *Romanche*.

The "Prix Laplace" is each year the prize of the first scholar of the Ecole Polytechnique, and thus fell to M. A. C. Rateau.

—We have received from Dr. Henry C. Chapman an interesting brochure entitled "History of the Circulation of the Blood," in which he concludes that the discovery of the circulation of the blood belong to no one age, country or person. Its history, extending over a period of 2000 years, attracted the attention of the great medical minds of all time. "Such a history ought to encourage every student, for however trivial and unimportant his

experiments or observations may appear at the time, every new fact once well established will sooner or later assume its appropriate place as a part of some future generalization; the chain of facts leading to a great discovery being united together like living things, each linked, those that have passed away with those still to come."

— Two Japanese naturalists, I. Iijima and C. Sasaki, have published in English an appendix to Memoir, vol. I, part I of the Science Department of the University of Tokio, on the Okadaira shell mound at Hitachi. The contents of this mound are compared with those from the Omori shell mounds described and figured by Professor E. S. Morse. The pottery, stone and horn and bone implements are of the same primitive nature as those from the Omori mound. Among the great quantity of bones only a single human one was detected. This was a femur roughly broken off at each end, and from the fact that it was broken in the same way as the bones of other mammals, the authors suggest that it might be taken as an evidence of cannibalism. Bones of the ox also occurred, which are regarded as "cases of intrusion unless we suppose the wild ox has existed in Japan." The illustrations are well drawn and printed by Japanese artists.

— The Zoölogischer Jahresbericht for 1882, IV, abtheilung, vertebrata, has been lately received (June 23). It forms a volume of 300 pages, and has the same excellencies as have characterized its predecessors, *i. e.*, the full abstracts of articles and works of a general nature, as well as matter pertaining to systematic zoölogy.

— The French Société d'Acclimatation has awarded the gold medal offered by the minister of agriculture to Dr. Dareste, the famous embryologist, for his researches in artificial incubation.

— Alphonse Lavallée, head of the very extensive arboretum at Segre, near Paris, died in June last at the age of forty-nine. He was the leading European collector and student of trees, and the author of the Arboretum Segrezianum; his latest work was an illustrated monograph of the large flowering Clematis, while at the time of his death he had nearly ready for the press, an illustrated monograph of the genus Cratægus.

— A brief memoir of the late Dr. Hermann Müller of Lippstadt, has been written by Ernst Krause, the proceeds of the sale of which are to be added to the "Müller Fund." The brochure contains an excellent autotypic portrait of the deceased, and the memoir is accompanied by a chronological list of Müller's writings.

— The death is announced at Breslau of the well-known botanist and palæontologist, Dr. Göppert, in his eighty-fourth year.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, May 31.—Communications were read by Mr. James E. Benedict on the recent cruise of the steamer *Albatross* in the Gulf of Mexico and Caribbean sea; by Ensign E. E. Hayden, U.S.N., on a new method of figuring fossil leaves and other objects by the aid of photography; by Mr. John A. Ryder on the development of viviparous minnows; and by Mr. Romyn Hitchcock on a collection of Foraminifera belonging to the genus Lagena.

NEW YORK ACADEMY OF SCIENCES, June 2.—A new process of cutting intaglios and cameos, so as to produce the finer effects of the ancient glyptic work, illustrated with specimens and with the present and the proposed machinery, was described by Mr. George F. Kunz; Mr. Edward W. Martin remarked on photo-micrography, processes and results, with illustrations.

June 9.—The scenery of the Rocky Mountain parks was described by the president with a series of lantern illustrations.

APPALACHIAN MOUNTAIN CLUB, June 11.—The following papers were presented: Notes taken on a recent trip to Black and Koan mountains, N. Carolina, A. E. Scott; A trip to the Sourdnahunk mountains, near Ktaadn, Geo H. Witherle; The mountains near Lakes Willoughby and Memphremagog, C. E. Fay, J. R. Edmands.

OTTAWA FIELD NATURALISTS CLUB.—During 1882 and 1883 this society has given five soirées, at which the following papers were read: No. 1, December 6, 1882, "President's inaugural address," J. Fletcher; No. 2, January 19, 1883, "The Laurentian system," F. D. Adams, and report of the Mineralogical branch; No. 3, "The fresh-water fishes of this vicinity," N. B. Small, and report of the Conchological branch; No. 4, "Notes on and description of some fossils from the Trenton limestone," W. R. Billings; "A note on *Triarthus spinosus* Billings," H. M. Ami; report of the Palæontological branch and report of the Ornithological and Zoölogical branch; No. 5, "The ducks of this locality," W. P. Lett; report of the Botanical branch and report of the Entomological branch.

Three excursions were held during the season of 1883: To King's Mere on 8th June; Deschene's mills on 2d September and Brigham's quarries on 21st October.

The council caused to be printed the transactions (No. 3) of the club for the year 1881–'82, consisting of sixty-six closely printed pages and two excellent plates. The transactions contain, in addition to the papers and reports read before the club, a list of the birds so far recorded from this locality.

AMERICAN PHILOSOPHICAL SOCIETY, April 18.—Extract from a Report on the Ham's Fork coals of Wyoming Terri-

tory, by P. W. Sheafer, were read. Mr. Lesley exhibited models of the Nittany valley and Bald Eagle mountain, and of the Jones mine, made by Mr. Harden. Dr. Hunt gave an account of his examination of the Jones and other iron mines, and assigned them all to the horizon of H. D. Rogers' primal slates, though they lie in immediate contact with the Trias. Dr. Frazer said that facts show that some of the mines penetrate the Trias, yet the triassic iron-ore deposits may be merely the redeposited detritus of more extensive primal slate iron ores.

May 2.—Mr. Phillips made a communication "On a supposed Runic inscription near Yarmouth, N. S.," and exhibited a photograph and a squeeze from it. Mr. Ashburner exhibited recently printed sheets of cross sections made by the Geological Survey in Schuylkill and Lucerne counties, and explained some of the peculiarities of structure.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Feb. 21.—Mr. Meehan described an abnormal *Halesia tetraptera*, with separate petals and leaves like those of the apple. The plant grew under similar conditions to numerous other normal seedlings and was the offspring of the same tree. Mr. Lockington considered this a case of reversion. Professor Heilprin exhibited specimens of carboniferous fossils, with Phillipsia, and along with them an ammonite, the oldest yet discovered, which he named *Ammonites parlaii.*

Feb. 28.—Dr. Leidy directed attention to specimens of a Distoma from the mouth of the alligator. *Distoma oricola* was proposed as the name. Examples of *Filaria horrida*, from the throat of the American ostrich, were shown, and also some filariæ from the marsh owl. The last accorded so closely with the *Filaria labiata* of the black stork of Europe and North Africa, that the speaker believed them to be the same species. Dr. Randolph detailed the results of experiments upon the digestion of boiled and unboiled milk, and announced his conclusion that the latter had the advantage as a nutrient.

March 3.—Dr. Leidy stated his belief that the species of *Apsilus dictyophora*, and Cupelophagus described by himself and others were really but one species. Miss Foulke maintained the distinctness of the forms described by Forbes and Meznichow, and described *Trachelius leidyi*, a ciliate infusorian found in Schuylkill water. Dr. McCook described the cocoons of the few species of orb-weaving spiders which make more than one cocoon.

March 13.—Mr. Ford exhibited specimens of *Zirphæa crispata* found in driftwood at Atlantic City. Professor Heilprin recorded the finding of *Porpita linnæana* near Cape May, and Mr. Tryon remarked that in 1876 he found an example at Atlantic City. Mr. Potts stated that the stems of Urnatella on the dry sponge-crust collected by him at Fairmount had commenced to show signs of life.

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NOTES ON A NEVADA SHELL (PYRGULA NEVADENSIS).

BY R. ELLSWORTH CALL AND C. E. BEECHER.

THIS form was described by Dr. R. E. C. Stearns[1] from material furnished in part by one of the present writers. The description was based upon the external characters presented by the shell alone, for at that time material containing soft parts had not been discovered. Since the printing of the description opportunities were afforded us to make extensive collections of recent and Quaternary shells in the Great Basin, and the biologic and climatologic results of our study are now being formulated for publication under the auspices of the United States Geological Survey.

The examinations made along the south and west shores of Pyramid lake, Nevada, demonstrated the existence of this form, Pyrgula, in countless thousands in that remarkable body of water. At a single locality more than a gallon was obtained, associated with many hundreds of *Pompholyx effusa* Lea, and many *Physa humerosa* Gould. From this material a large number of specimens, containing the dried animals, was assorted and sent to Mr. Beecher, who has successfully worked out the dentition, and described it as below :[2]

The genus Pyrgula has not received a uniform treatment at the hands of systematists, none of whom have yet studied the denti-

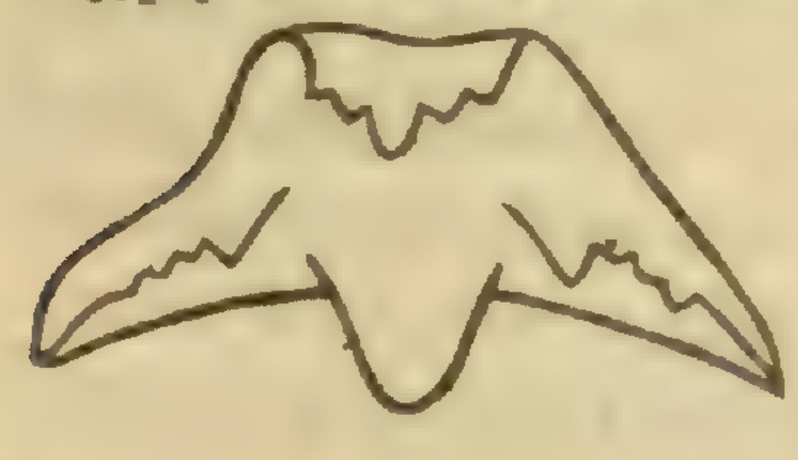
[1] Proc. Phila. Acad., 1883, pp. 171–176, with figure.

[2] Mr. Beecher is alone responsible for the dentition as here given. His work is most careful and painstaking, and we hope jointly to present, in the course of time, very much more of his careful work in dentitions.

tion, and most of whom have never seen even the shell. Nearly or quite all who have based their opinions upon actual study of shells, have been obliged to content themselves with such external characters as the shells furnish, and these are often most unsatisfactory. Pyrgula is operculated, carinated, and with the spire well elevated, thus presenting features which might excuse a reference of it to the Melaniidæ, which has been actually made by most authors. Until the work of Stimpson[1] on the Rissoidæ the genus appears to have been placed in some most remarkable positions. At that time nothing was known except the obvious characters furnished by the test, and some observations by Moquin-Tandon on the form common to the rivers of the mountainous portions of France,—*P. bicarinata* Bourg.

In the system here provisionally adopted from Stimpson,[2] Pyrgula lies between Paludestrina and Tryonia, having superficial characters intermediate to those genera. Dr. W. H. Dall has suggested, in a recent letter, that possibly the Pyramid lake shell would be found to rank in Amnicola, basing his opinion upon the operculum, which certainly possesses some Amnicoloid characters, and upon the produced anterior part of the aperture, as mentioned in the generic description by Christoforo and Jan. But now the work of Mr. Beecher for the first time enables us to correctly place it among the Rissoidæ. My collaborator has made no comparisons with figures resulting from the work of others, and I hence introduce here a few notes based upon the observations of Troschel, Moquin-Tandon, Stimpson and myself.

The formula for the rhachidian tooth of the genus Amnicola is $\frac{3.1.3}{4.1.4}$. The tooth itself is about three times broader than high (Fig. 6), has a greater number of basal denticles than the corresponding tooth of Pyrgula; the formula for that genus being $\frac{4.1.4}{1.1}$. The peculiar tongue-shaped process of this tooth in Amnicola is entirely wanting in Pyrgula, and the lateral lobes are more denticulate. Paludestrina has a similar formula for the rhachidian tooth—$\frac{4.1.4}{1.1}$—but differs in other important particulars.



6.

Rhachidian tooth of *Amnicola porata* Say. Enlarged from Stimpson.

[1] "Researches on the Hydrobiinæ and allied forms." Smithsonian Misc. Coll., No. 201, 1865.

[2] *Loc. cit.*, p. 47.

Comparing these formulæ, the necessity of complete separation from Amnicola is sufficiently obvious. Whether the produced aperture of Pyrgula, as figured by Chenu,[1] is of generic value is quite uncertain, for Pyrgula is most certainly a vegetarian. Though the genus is said to be confined to the fresh waters of the mountainous areas which it inhabits, it is, in the North American localities, found in brackish water-lakes alone.

It may profitably be further noted that the dentitions given by Troschel, Moquin-Tandon and Stimpson differ very much, even more than should be allowed to pass without comment. It has been found by Mr. Beecher, and corroborated by the senior author, that many descriptions are imperfect and will need revision. To this end we invite collectors to send to our addresses[2] any of the smaller species of fresh-water univalves which may chance to occur in their localities.

Following is the description of

The Dentition of Pyrgula nevadensis.

Jaw thin, membranaceous.

Odontopore .62^{mm} in length, and .15^{mm} in width. There are usually fifty-five transverse rows of teeth, arranged according to the formula 3–1–3, which is common to the family Rissoidæ.

Rachis distinct, occupying one-fourth the width of the ribbon. Rhachidian tooth (Fig. 1) short and broad, with the infero-lateral angles produced and slightly arcuate. On each side of the anterior face is a strong, short, conical process or basal tooth projecting outwards and somewhat downwards. Basal margin trilobate; central lobe truncate. Cusp curved forwards and extended into a strong denticle with four smaller ones on each side. The formula of the denticles for this tooth would therefore be $\frac{4+1+4}{1+1}$.

Body of intermediate tooth (Fig. 2) subrhomboidal, with the infero-interior angle slightly produced and with an angulation in the margin above. From this point there is a thickening or ridge extending towards the fixed end. Peduncle longer than the body of the tooth. Upper margin abruptly curved forwards and marked by seven denticles, of which the third inner one is usually the largest; the formula for this tooth may be written 2 + 1 + 4.

Inner lateral tooth (Fig. 3) spoon-shaped, with the infero-interior margin angular. Upper anterior margin marked with a fringe of about twenty-four denticles decreasing in length from the inner extremity. Peduncle straight, wider than the body.

Outer lateral tooth (Fig. 4) falciform, straight along the peduncle. Anterior margin and extremity denticulated with thirty minute denticles, usually decreasing in length towards the distal extremity, but subject to some variation. The denticulate margin extends more than one-third the length of the tooth. Peduncle slender and nearly straight.

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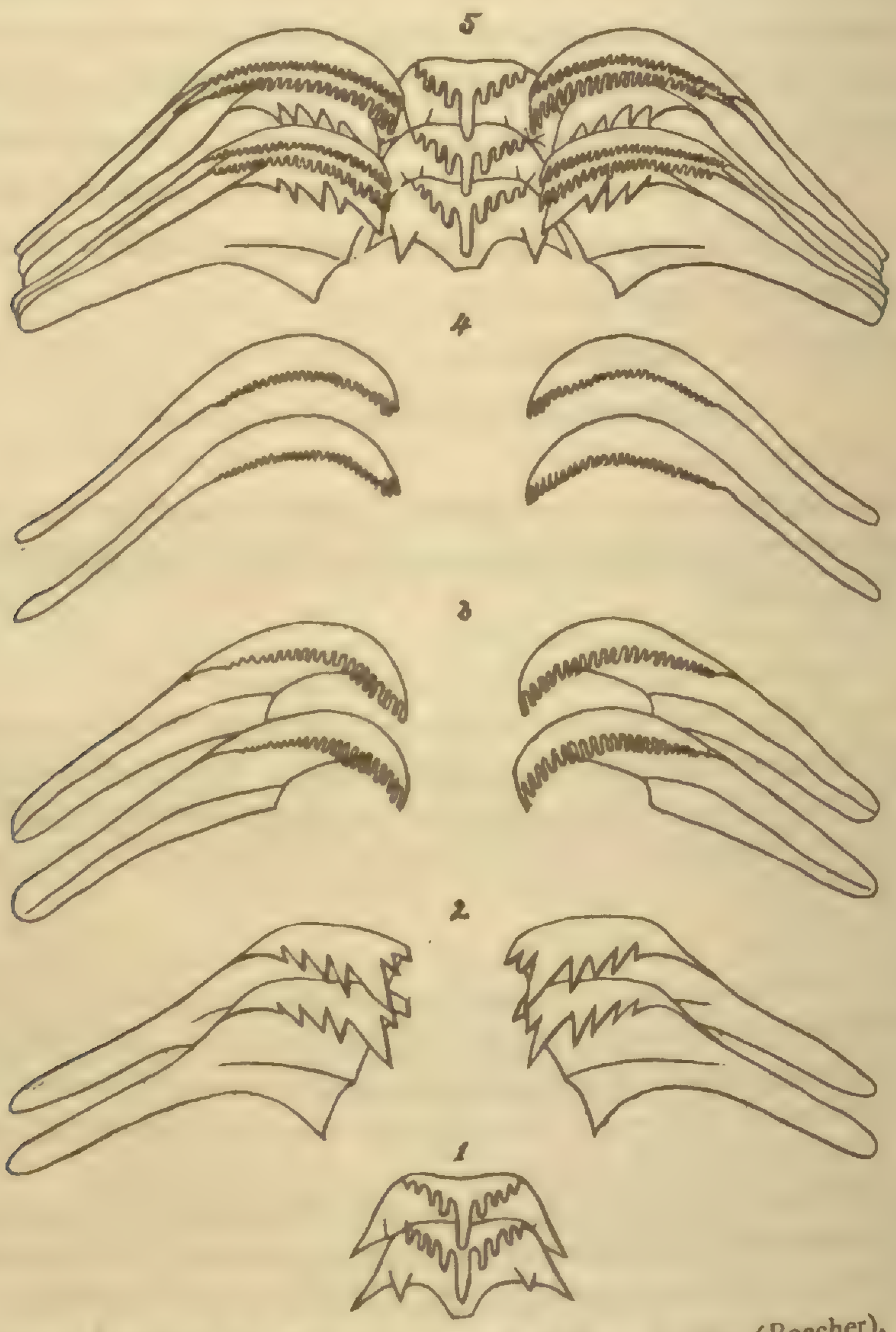
[1] Manuel de Conchyliologie, Tome 1, 294, Fig. 2029.

[2] R. Ellsworth Call, Des Moines, Iowa, or to C. E. Beecher, 273 Hudson ave., Albany, N. Y.

The formula for the denticles is $30\text{–}24\text{–}7\text{–}\frac{4+1+4}{1+1}\text{–}7\text{–}24\text{–}30$.

There is a marked variation in the character of the denticles on the intermediate and lateral teeth. On the intermediate they are large, angular and somewhat irregular. The lateral teeth are uniformly marked by a regular fringe of slender denticles, which are much smaller on the outer lateral.

Some portions of the membrane and different specimens show considerable variation in the length and strength of the denticles on the lateral teeth, and sometimes their number seems subject to some mutation. The numbers given in the formulæ were averaged from several enumerations, and represent the comparative denticulation of the teeth.



Lingual dentition of *Pyrgula nevadensis* Stm., × 500 (Beecher).

DESCRIPTIONS OF FIGURES.

FIG. 1.—Rhachidian teeth.

FIG. 2.—Intermediate teeth.

FIG. 3.—Inner laterals.

FIG. 4.—Outer laterals.

FIG. 5.—A portion of the odontophore representing the teeth in their natural position. All enlarged to 500 diameters.

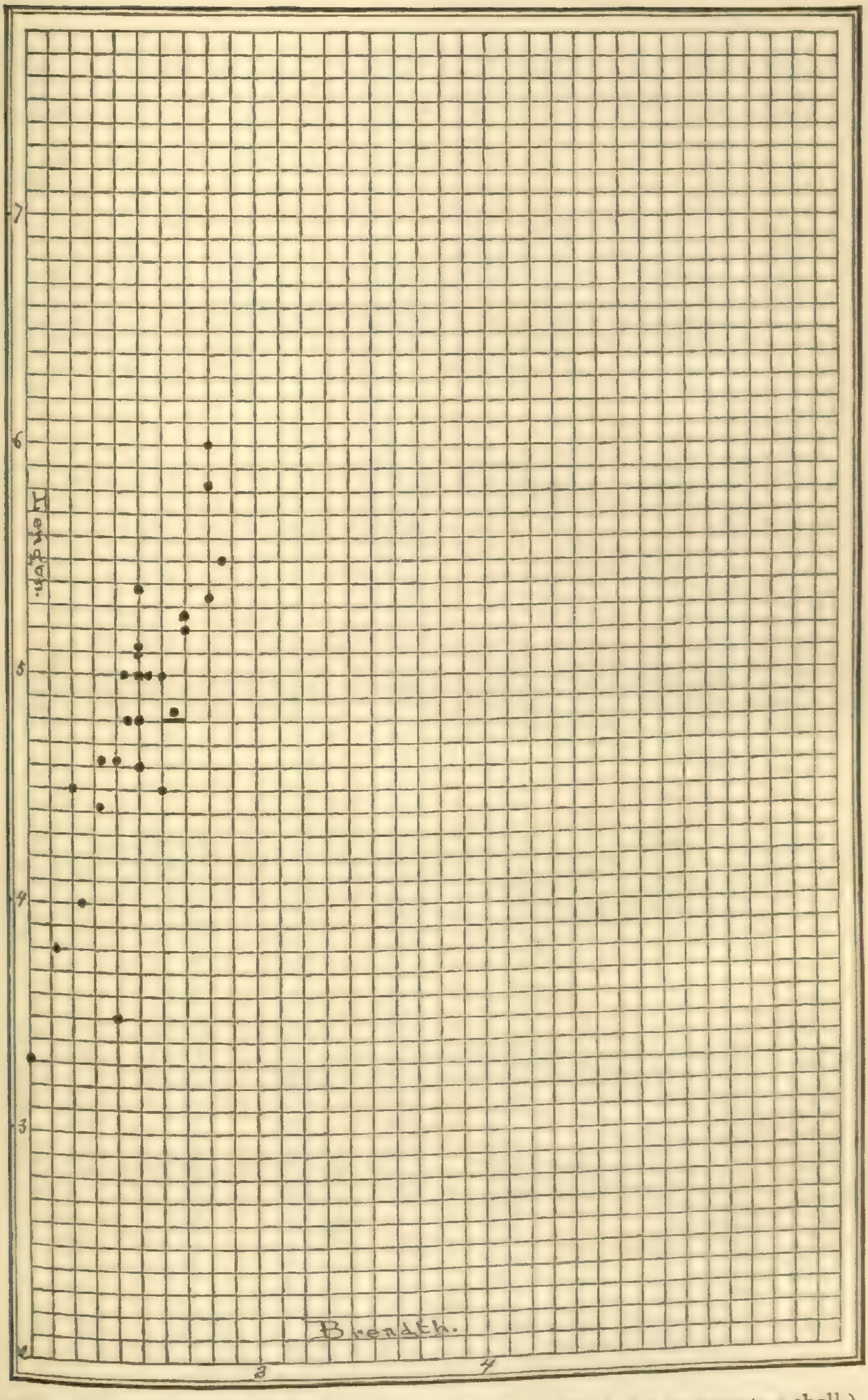


Chart showing Variations of Pyrgula nevadensis. (Each dot represents a shell.)

Pyrgula nevadensis varies in size within rather wide limits. Twenty-five specimens, taken at random, present the following averages: Length 4.83^{mm}; breadth 2.65^{mm}. These proportions are best shown graphically, as are also the extremes of variation, by the accompanying plate, XXV, in which 2^{mm} is adopted as the origin of the coördinates. Each small square represent a .10^{mm}. The dot underlined represents the *average* of the specimens measured. At some future time more complete notes on this species, and on those inhabiting the salt springs and lakes of the Great Basin, from a biological standpoint, will be presented the readers of the NATURALIST.

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ASPECTS OF THE BODY IN VERTEBRATES AND ARTHROPODS.

BY A. S. PACKARD.

UNDER the title "Aspects of the Body in Vertebrates and Invertebrates" (London, 1883), the venerable and distinguished English anatomist and palæontologist, Professor Sir Richard Owen, renews in a vigorous way the old discussion originally begun by Geoffroy St. Hilaire. The view in question is tersely presented in St. Hilaire's answer to Dugès, quoted by Professor Owen, when he replied by reference to "Fig. 2 de la septième planche: Là se trouve effectivement représenté un homard couché sur le dos et montrant distinctivement ses viscères dans la position où le sont les viscères des mamifères placés sur le ventre." This view was combatted by Cuvier, and in this respect he has been followed by Gegenbaur.

In his able essay Professor Owen places himself on the side of St. Hilaire, and the special point in vertebrate anatomy which he brings forward to support this opinion is the homology of the conario-hypophysial tract, which he regards as "the modified homologue of the mouth and gullet of invertebrates;" and at the end of chapter I he concludes that "the surfaces or aspects of the body which are truly homologous in the snake and caterpillar are the *neural* and the *hæmal*, not the *dorsal* and the *ventral*."

In his second chapter, entitled "Cerebral homologies in vertebrates and invertebrates," Professor Owen quotes our statement[1]

[1] Second report U. S. Entomological Commission. Chapter XI. The brain of the Locust, p. 224. 1880.

that "the brain and nervous cord of the fish or man is fundamentally different, or not homologous with that of the lower or invertebrate animals;" and then proceeds to criticize it.

The chapter on the brain of the locust was written for the unscientific as well as the scientific reader, and the introductory part was presented in a terse, perhaps dogmatic way, for the sake of clearness.

The author, without taking time and space to discuss at length this broad question, which requires a far wider acquaintance with anatomy and embryology than he claims to possess, would beg leave to briefly present some facts and considerations which seem to him to support the view he adopted as to the lack of homology between the nervous system of arthropods and vertebrates.

These facts relate to the histology and the histological topography as well as general morphology of the system in question, and the general relation of the viscera to the body-walls of arthropods as compared with vertebrates.

1. Histology.—There are but two histological elements in the brain and spinal cord of vertebrates, *i. e.*, ganglion-cells and nerve-fibers proceeding from them. In worms (and mollusks so far as known) and especially in the brain (procerebrum, as we may call it to distinguish it from the cerebrum of vertebrates) and other ganglia of Crustacea and insects, besides these two elements there is a third substance, the *punktsubstanz*, discovered by Leydig, and farther described by Dietl and Krieger, and for which we would suggest an English equivalent, the *myeloid substance.*

2. Histological topography.—The arrangement of the ganglion-cells and other tissues in the ganglia of arthropods is not homologous with that of vertebrates. In the brain or any of the post-œsophageal ganglia of arthropods, there is a central mass formed of the myeloid substance, which is enveloped by a cortical layer of mostly unipolar ganglion-cells. The fibers from the ganglion-cells pass into and emerge again from the myeloid substance, which is a tangled mass of minute fibrillæ. The fibers from certain of the ganglion-cells we have clearly seen to pass through or over the myeloid substance and to form both the transverse commissures of the brain and also the two main longitudinal commissures connecting the chain of ganglia. But the fibers from the majority of the ganglion-cells appear, as Leydig holds, to break up into the tangled mass of extremely fine fibers, which when cut

through presents a dotted or granulated appearance. This myeloid substance remains unstained, while the ganglion-cells readily stain by reagents.

In the brain and other ganglia of vertebrates, on the other hand, the ganglion cells are internal, the fibers arising from uni, bi or multipolar ganglion-cells passing outside. In invertebrates, at least arthropods, there is no "white" or "gray" substance; none such has been described by Leydig or the later students of the central nervous system of arthropods.

Histogenesis.—If we look at the genesis of the ganglia of arthropods, we see that they consist at first wholly of spherical cells; the fibers and myeloid substance being secondary products, and their position is not homologous with that of the ganglia in vertebrate embryos. The reader is referred to Fig. 246 in Balfour's Comparative Embryology, Vol. II, p. 343. The section of the spinal cord of a seven days' chick there figured, shows that the cord is early differentiated into the internal gray mass, consisting of round cells, enveloping the spinal canal, while the cortical white substance or column surrounds the mass of ganglion-cells. In the annelidan worms and the arthropods, the embryonic ganglion is a much simpler structure, consisting of a mere mass or ball of ganglion-cells, with incipient fibers passing from them. Certain of these fibers grow longer, forming the commissures, transverse and longitudinal, connecting the ganglia. At first, then, the nervous system of the higher worms (those with a ganglionated chain) and arthropods, consists of a series of disconnected ganglia, which eventually become connected by secondary products, the commissural fibers. The fact that in worms the brain is at first separate from the rest of the ganglia, as stated in Balfour's Embryology (I, p. 291), is not of particular significance since all the ganglia, at least in Crustacea and insects, are at first disconnected from each other.

Embryology appears to give no countenance to the view held by some authors that the brain of an arthropod may represent the nervous system of the vertebrate, and the post-œsophageal chain of ganglia the sympathetic system of the vertebrates.

There seems to be a unity of plan, so to speak, in the development of the nervous system of the arthropods, and how radically different that is from the mode of genesis of the vertebrate nervous system may be seen by reference to Balfour's work (II,

250–252) or that of other observers. While the nervous system of all animals arises from the ectoderm (epiblast), as Balfour states: "In all Chordata an axial strip of the dorsal epiblast, extending from the lip of the blastopore to the anterior extremity of the head, and known as the medullary plate, becomes isolated from the remainder of the layer to give rise to the central nervous axis;" in tunicates as well as vertebrates this plate is converted into a tube or canal, which lies wholly above the alimentary tract. It is this striking feature in embryo tunicates which mainly seems to justify their elimination from the worms and

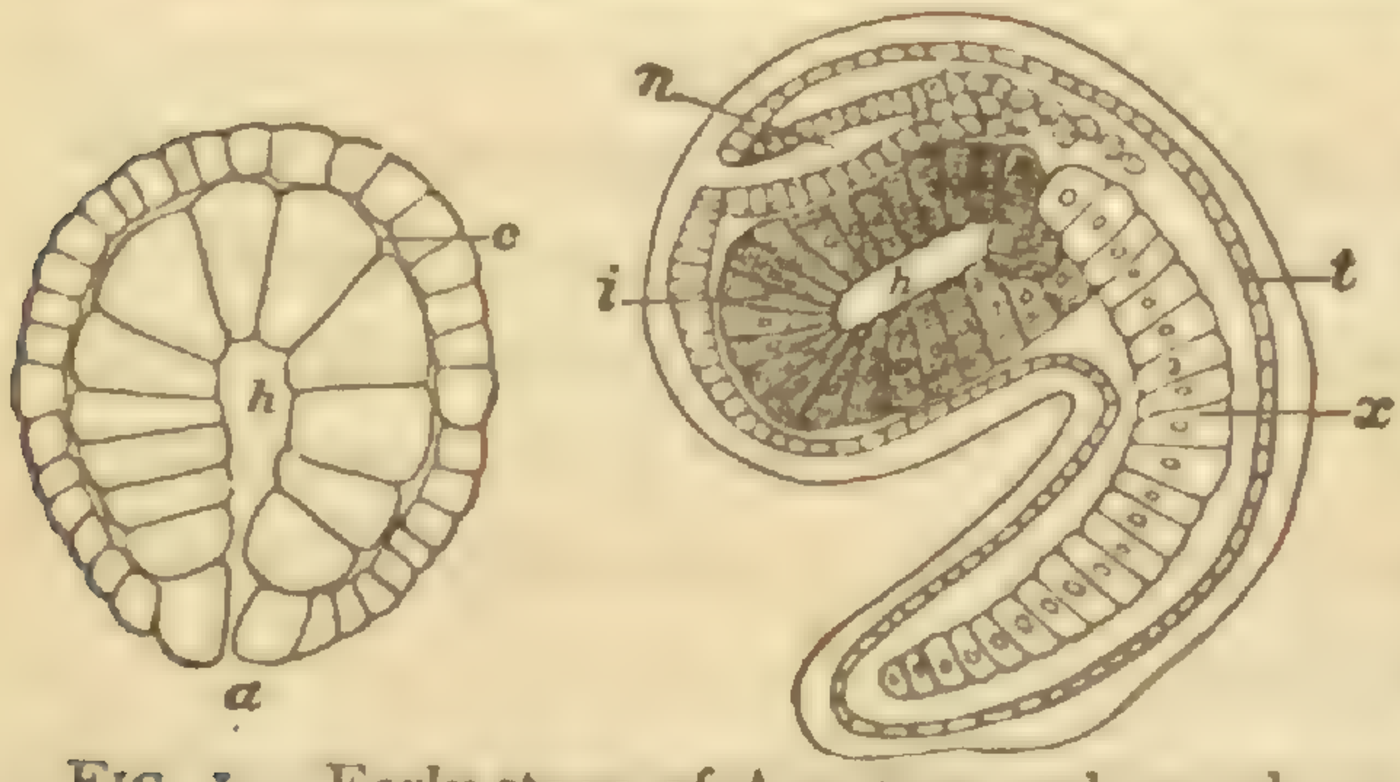

FIG. 1.—Early stage of Ascidian embryo, showing the nervous tube *n*, open in front and situated dorsally above the alimentary tube (*h*), as in vertebrates.

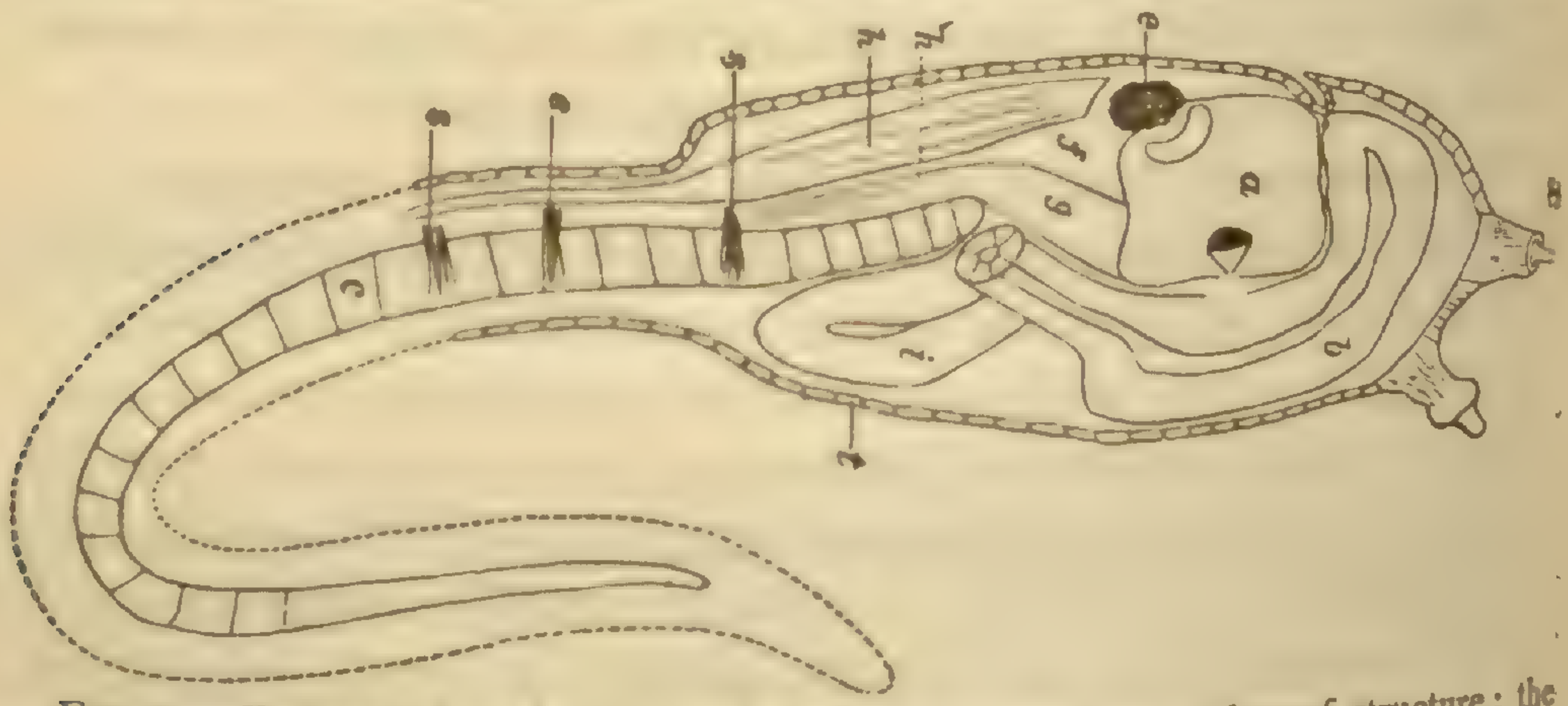

FIG. 2.—Embryo of an Ascidian, showing the vertebrate plan of structure; the nervous system *h'*, *h* with the spinal nerves (*s*) being situated dorsally above the notocord (*c*) and alimentary canal (*b*, *i*).

indicates their proximity to the vertebrates, as this seems to be a more truly vertebrate feature than even the possession of a notocord.

FIG. 3.—Section of a vertebrate embryo (a fish). *n*, nervous tube, open in front and situated dorsally; *ch*, notocord; *bb*, mouth; *e*, alimentary canal; *a*, place of vent; *m*, mesoderm.

Balfour states on p. 342: "The spinal cord, shortly after the closure of the medullary canal, has, in all the true Vertebrata, the form of an oval tube; the walls of which are of a fairly uniform thickness, and are composed of several rows of elongated cells. This cord, as development proceeds, usually becomes vertically

prolonged in transverse section, and the central canal which it contains also becomes vertically elongated." Then follows the differentiation (1) of the epithelium of the central canal, (2) of the gray matter of the cord, and (3) of the internal coating of white matter. "The white matter is apparently the result of a differentiation of the outermost parts of the superficial cells of the cord into longitudinal nerve-fibers, which remain for a long period without a medullary sheath. * * * The gray matter and the central epithelium are formed by a differentiation of the main mass of the spinal cord."

There thus appears to be a lack of homology in the histological topography and origin of the nervous system in Chordata as compared with the annelidan worms and the arthropods.

The relation of the nervous system of arthropods is constant; after the stomodæum has been formed, commissures from the brain pass down and connect the latter with the subœsophageal ganglion, which is ventral. This relation of the postœsophageal nervous system to the ventral side of the body is as constant as the disposition of the ventral surface of the embryo of insects before the revolution of the embryo, or of the embryos of annelid worms and Crustacea. The position of the arthropod embryo is the reverse of that of vertebrates. The vertebrate disposition of the primitive nervous system is also seen in the embryo tunicate (Figs. 1, 2).

FIG. 4.—Relations of the nervous system of an embryo Orthopterous insect to the body-walls. *br*, brain: *sbg*, subœsophageal ganglion; *ng*, nervous cord; *st*, stomodæum; *pr*, proctodæum; *mv*, malphigian tubes; *mesen*, mid-intestine; *ht*, heart; *md*, mandibles; *mx*, *mx'*, 1st and 2d maxillæ. From Ayers, with changes.

Morphology.—The brain of the Arthropoda is contained in a structure which throughout is lacking in homology with that of vertebrates. The crust, the segments, and the appendages especially, have nothing in common with vertebrates, though the functions are, in a degree, the same. The origin and homologies of the sensory organs are, *ab initio*, different. For example, the eyes of arthropods are not truly homologous with those of vertebrates; the cornea is simply a number of epithelial cells, while in verte-

brates the eye externally is an ingrowth of the epiblast. As the wings and legs of insects and organs of hearing and of smell are not the homologues of the parts which function as such in vertebrates, so we are not inclined to regard the heart and nervous system of arthropods as truly homologous with the corresponding organs of vertebrates. If there is such a fundamental difference in the two types as regards the relations of the viscera to the body-walls, and if this relation is common to all arthropods and the Annulata, we shall have to go back to the hypothetical common ancestors of the tunicates and vertebrates on the one hand and of the Annulata and Arthropoda on the other, for the means of comparison. It is not impossible that in animals allied to the planarian or nemertean worms, whose nervous system consists of a pair of dorsal ganglia, with two or more pairs of nerves passing backward, that the common origin of the prochordate nervous system, and that peculiar to annelids and arthropods, may yet be discovered.

So also the resemblance of the brain, dorsally situated, of the cephalopods, enclosed as it is in an imperfect cartilaginous capsule, is interesting, but the relations are those of analogy or adaptation, and not of affinity. The mollusks, the annelids, the arthropods and the vertebrates appear to be highly specialized branches, and where there appear at first sight to be direct, cross-homologies, so to speak, between them, these are rather independent structures, the result of adaptation rather than of direct descent. Examples of such, we believe, are the eye, the brain and the heart of the cephalopods.

The unity of organization in the animal world is seen rather in the homology of the cellular structure, and in the common origin of all from unicellular forms; and among the Metazoa in the identity of the morula and gastrula conditions, or at least the germ-layers; and as regards the nervous system, in its origin in the epiblast, rather than in any special parts or organs of such highly elaborated and specialized types as are represented by the lobster, or butterfly, or fish.

The dispute between Cuvier and St. Hilaire and their followers was in part metaphysical. The old-time problems in transcendental anatomy, such as comparing a lobster to a vertebrate upon its back, the problems of fore-and-aft symmetry, and the question of torsion in the fore and hind limbs of mammals, have, if we are

not mistaken, lost much of their interest and value in the light of modern evolutionary problems, and savor more of scholasticism than of science.

At all events the present problem is, as embryology shows, so remote in its bearings; the common point of origin of arthropod and vertebrate, the fork in the primitive developmental path where the two branches began to diverge, is set so far back in the animal scale, and is so remote in geological time, that with our present knowledge we are inclined to regard the consideration of such problems as belonging rather to metaphysics than to pure science; although it should be granted that farther researches among the lower worms may yet result in the discovery of facts bearing upon the origin of the singular differences in the disposition of the arthropod and vertebrate nervous systems.

In conclusion, therefore, we are led to endorse the following opinion of Gegenbaur, in his Comparative Anatomy (English translation): "The greater size of the cephalic ganglion compared with that of the ventral ganglia, has been already seen in many of the Annulata; in the Arthropoda it is ordinarily still more distinct; this condition may be partly explained by its relations to the more highly developed organs of sense, if we recognize in the dorsal œsophageal ganglion something similar to the brain of the Vertebrata. Led by an idea of this kind, some have compared even the ventral ganglia, or ventral medulla, with the dorsal medulla of the Vertebrata, and have striven to carry the comparison still farther; these attempts ignore the complete difference between the type of structure of the Arthropoda and of the Vertebrata," p. 252.

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THE NORTHERNMOST INHABITANTS OF THE EARTH.

An Ethnographic Sketch.[1]

BY EMIL BESSELS.

THE Greenland coast bordering the entrance of Smith sound is peopled by Eskimos who are the northernmost inhabitants

[1] The present ethnographic sketch forms chapter XIX of "Die Amerikanische Nordpol-Expedition," by Emil Bessels (Leipzig, Wilhelm Engelmann). It was kindly translated by the author for the NATURALIST, as of special interest at present on account of the station at Lady Franklin bay. The original is more fully illustrated.—EDS.

of our planet. Like most other tribes of Eskimos, they call themselves Inuit, or men, not being familiar with the expression Eskimo.

This name was first given, as it seems, to the Inuit of Labrador by the Nascopi Indians and by other families of the Algonkins. In the language of the Abnaki, for instance, *eski-m ∞ha^n* means *he raw eats it;* and according to the "Dictionnaire et grammaire de la langue des Cris," by A. Lacombe, *aski* = *cru* and *mowew* = *il le mange; askimowew* would therefore signify *raw he eats it.* In his valuable paper "On Algonkin names for man," published in the Transactions of the American Philological Association for 1871, Mr. J. H. Trumbull informs us that the Algonkins of New England were in the habit of calling the Mohawk tribe of the Iroquois *Mohowang-suck* or *Manquân-og*, namely, cannibals or man-eaters. For moho means to eat and moowhan, according to Eliot's Bible, he eats what lives. The formation of the word Esquimantsic, which is found in most text-books on ethnology, is probably erroneous.

It is Captain John Ross to whom we owe the first intelligence of these remote people. In the narrative of his exploring cruise up Baffin bay, during the year 1818, he makes mention of them as "Arctic highlanders," a name which should hardly be admitted, since these Eskimos invariably inhabit the coast. Ross and his companions were evidently the first strangers these people had beheld. The two men-of-war they considered to be huge monsters with wings, while they thought that the sailors themselves were inhabitants of the sun and the moon, who had suddenly descended upon them. Their garments consisted of skins; they had dogs, sledges made of bone, large narwhal tusks converted into spears, and poor knives, apparently manufactured of meteoric iron.

The second contact of these savages with white men occurred during the period of the Franklin's search-expeditions.

In 1849 the *North Star*, one of the tenders of the English squadron, wintered in their vicinity in Wolstenholme sound, and the remaining vessels of the fleet now and then came in contact with these Eskimos. Kane was the first to remain among them for any length of time, as Hayes did later. Since then they were met occasionally by English whalers who, on their way to Lancaster sound, stopped at the fast ice of the coast in the vicinity of Cape York while waiting for open water.

Kane estimated their number at 150, Hayes at 100, and our own census led to a result closely comparing with the latter. We personally saw 102 individuals, but the entire tribe did not exceed this number by more than eight or ten.

For the sake of brevity we will name these "*ἔσχατοι ανδρῶν*" Itanese, the name being derived from Ita, their most northerly settlement at the head of Foulke fjord. It remains to be said, however, that the entire tribe is not permanently established there, a part of them scattering over several other localities.

Their extreme northern migrations approximate the 79th parallel; southward not farther than Cape York. Hedged in from the north by the huge Humboldt glacier, from the south by the long continued precipitous edges of other ice streams, which up to the present time have not received any names, it is evident that the field of their rambles must necessarily be of very circumscribed area. Eastward they cannot move because from that direction they are barred by the inland ice. In addition to this, superstition as regards evil spirits prevents their venturing far inland. Occasionally, it seems that they cross Smith sound and visit the coast of Ellesmere land. Such expeditions, however, are not frequently undertaken, because the ice is exceedingly hummocky and scarcely passable on sledges, even should the currents and the high winds in this narrow sound permit the formation of a continuous ice-covering.

Doubtless their ancestors inhabited this barren coast for many centuries before them. It is hardly possible to determine the time at which the latter settled there; any attempt to do so would lead to useless speculations. It has been believed that not only the century but very nearly the year might be determined during which the Inuit first set foot upon Greenland; but in the absence of all reliable data we must mistrust such assertions.

This much we may say, however, with certainty, that the Inuit at the time they reached Greenland were typical Eskimos, and that since that time, where the influence of the white men has not reached them, they have scarcely changed their customs and habits. So trifling indeed is the progress which this people has made in the course of centuries, that the implements of tribes which have been separated from each other for many ages, are so similar that discrimination between them is almost impossible. On the other hand we find a remarkable resemblance between the

primitive weapons of the palæolithic man of Europe and those at present used by the Inuit. Did we not know to what extent the complicated human organism is to be regarded as a product of adaptation to its surroundings, we might conclude from the similarity of the implements, that the Inuit are the nearest relatives of palæolithic man. We learn, however, from comparative anthropology how strikingly similar are the motives developed by nations even when separated by such great distances that practically they might be inhabitants of different planets. One of the most prominent English anthropologists felt himself called upon to defend this view. He even regarded such relationships as certain, but failed to furnish the requisite proofs.

Assuming as genuine the two well-known carvings in reindeer antlers, found in the Charente of France, which represent human figures, we must conclude that the physiognomy of palæolithic man was totally different from that of the Inuit. "*L'ensemble de la tête paraît intermediaire entre le type conventionel de Mephistophélès et la tête de François I.*" These are the words used with reference thereto by Mr. de Mortillet.

The physical type of the Itanese corresponds so thoroughly to that of other Eskimos that it is not necessary to give any special description. We may state, however, that we saw a number of men, brothers, whose height was almost six feet. In this instance the stature was inherited from the mother, who measured 5.6 feet, whereas the father was of medium size.

By the courtesy of different corporations, institutes and private persons, I had the privilege of examining and measuring more Eskimo skulls than any one of my predecessors. In this manner I obtained from the Academy of Natural Sciences of Philadelphia and from Dr. Hayes all the skulls collected by the latter in the vicinity of Ita.

The number of Itanese crania which admitted of accurate measurements amounted to 101. Of these 100 specimens could be used for the determination of the mean index of breadth. This amounts to 71.37. The mean index of height deduced from the measurements of 99 crania is 76.91. The maximum index of breadth was found to be 79.8; the maximum index of height, 81.8. The respective minimum indices were 63.4 and 78.0.

The complete record of these measurements may be found in Vol. x of the "Archiv für Anthropologie." The subjoined table

contains a series of mean indices of breadth and height of various other Eskimos:

Locality.	*Index of Breadth*	*Index of Height.*	*Number of skulls meas'ed.*	*Authority*
Unknown.....	70.4	73 7	24	Welker.
Danish settlements in West Greenland	72.6	73.7	21	Bessels.
West Greenland	71	75	10	Davis.
Northeast America.....	72	75	6	Davis.
West Greenland	71.8	70.5	5	Virchow.
East Greenland	72.9	74.2	4	Pausch.
Northwest America	72	75	4	Davis.

Samuel Kleinschmitt, among the authorities on Eskimo languages, distinguishes two main dialects in Western Greenland, the northern and the southern. "The former is harsher but at the same time clearer in enunciation, more particularly of the vowels. The latter is softer but at the same time more indistinct." According to this statement the dialect of the Itanese resembles more closely the southern. The vocalization is remarkably clear, the accent singing and gently waving, while the consonants, especially at the end of a word, are most obliterated.

As regards costume, that of the Itanese approaches in character the vestments worn by the inhabitants of Danish Greenland. Both sexes wear, during winter, underclothing made of bird-skins, the feathered side next the skin. A jacket (jumper) with hood attached, and the short breeches are made of the skins of the seal, reindeer, bear or dog, the pelt of the fox rarely being used. Double or triple fur stockings are covered by waterproof boots manufactured from tanned sealskin, but once in a while the outside covering of the foot is composed of bear-skin. The men fasten their boots a little below the knee by means of a draw-string just above the lower end of the breeches, while the women wear higher boots which almost reach to their hips. This constitutes the main difference between the male and female costume. The hood attached to the jacket of the man is rounded at its apex, but that of the woman is pointed. Married women wear this hood of considerable size, because their children are carried therein until two or three years of age. Gloves are made of tanned seal-skin or furs; mittens are the most usual form worn. During the summer the heavy jackets of bear-skin are exchanged for those made of seal-skin, and the underclothing is either left off entirely or worn without any exterior garment.

Their dwellings are arched huts of either snow or stone, or they are leather tents. During the cold season, as a rule, the structures of snow are inhabited, though occasionally those of stone; tents, however, are resorted to exclusively during the summer.

The invention of the dome, which was probably made independently in three different zones of our planet, may be considered of even greater credit to the Eskimo than the invention of the sledge. The Itanese are experts in the architecture of these semispherical or hive-shaped snow-huts. Their size depends on the number of inhabitants. About twelve feet may be regarded as the average diameter of the floor, the height being approximately one-half of this. Two feet to two and a-half is the length of the blocks of snow used in their construction; their height is from ten to twelve inches; their thickness from eight to ten inches. Longitudinally the section presents three different forms. Prominent amongst these is a trapezia with two sides slightly diverging; next an elongated oblong, and finally a trapez. The greatest angle of this last rarely exceeds 109°, and the smallest is not less than 70°.

To prepare these blocks a sword-shaped snow-knife is used, made either of wood, of the lower jaw of the narwhal, or of a walrus tusk.

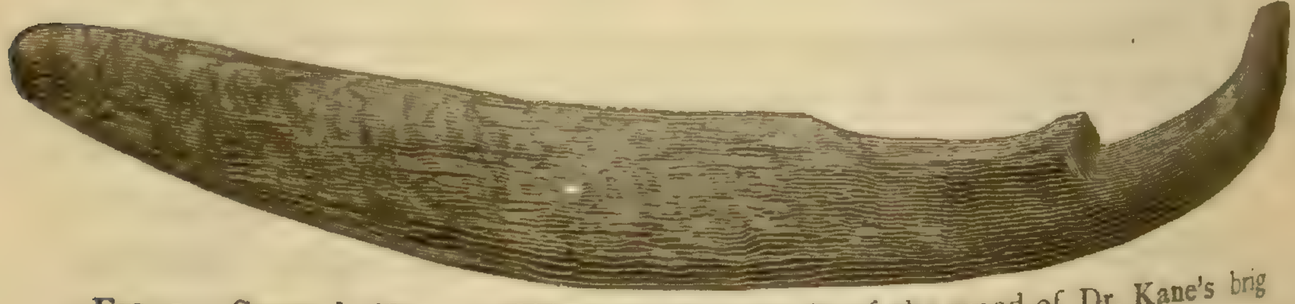


FIG. 1.—Snow knife, one-fifth nat. size, made of the wood of Dr. Kane's brig *Advance*, collected by Dr. I. I. Hayes.

Usually two persons are employed in the construction of a snow hut. While one is cutting the blocks the other joins them together. The row forming the foundation consists of rectangular pieces standing upright and forming a circle. The higher layers, however, form a spiral which is particularly pronounced on the apex of the dome. Each successive convolution has a greater angle of inclination than the preceding one. Lastly the door is cut out in the form of a gothic arch. In front of this is a short arched gang-way. Occasionally several of these huts are connected.

The interior arrangement of these dwellings is exceedingly simple. Opposite the door we find a low platform made of snow and covered with furs, which is used as a sleeping place. In case the hut is made of stone this platform is composed of the same material. Most important among the household utensils is the flat stone lamp which furnishes both light and heat. According to the size of the dwelling, one or two of these lamps are used. They are placed upon blocks of either snow or stone immediately by the side of the platform. Above the lamp is suspended, with cords of raw hide, an oblong stone cooking pot. Small racks, made of bone, serve for drying garments.

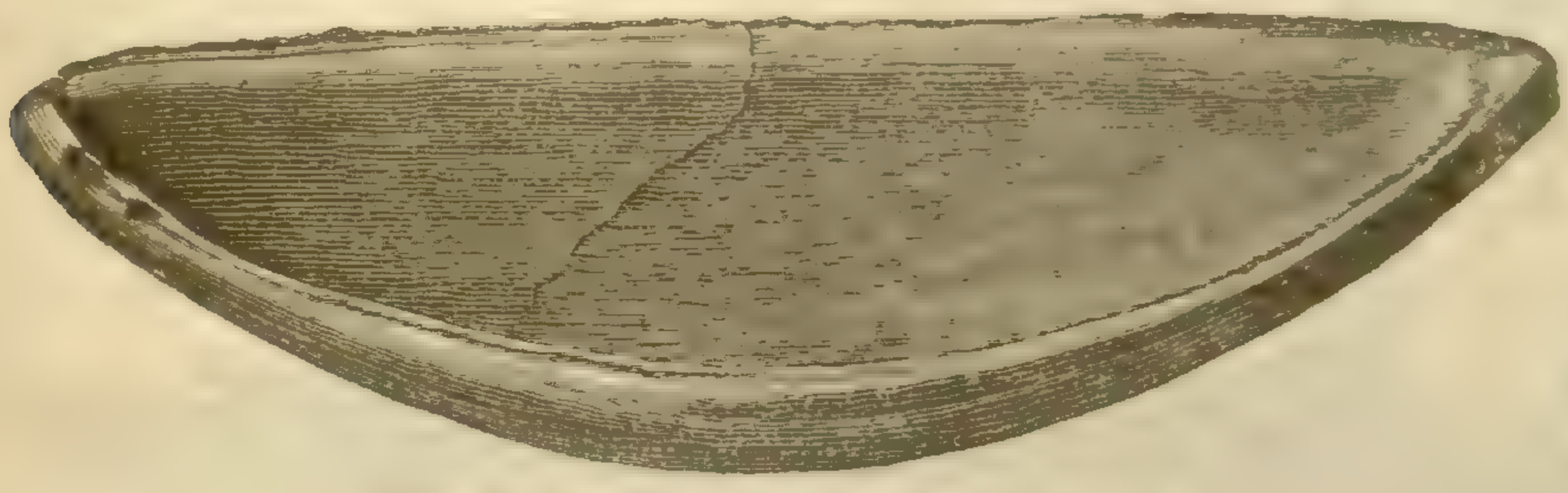


FIG. 2.—Stone lamp made of steatite.

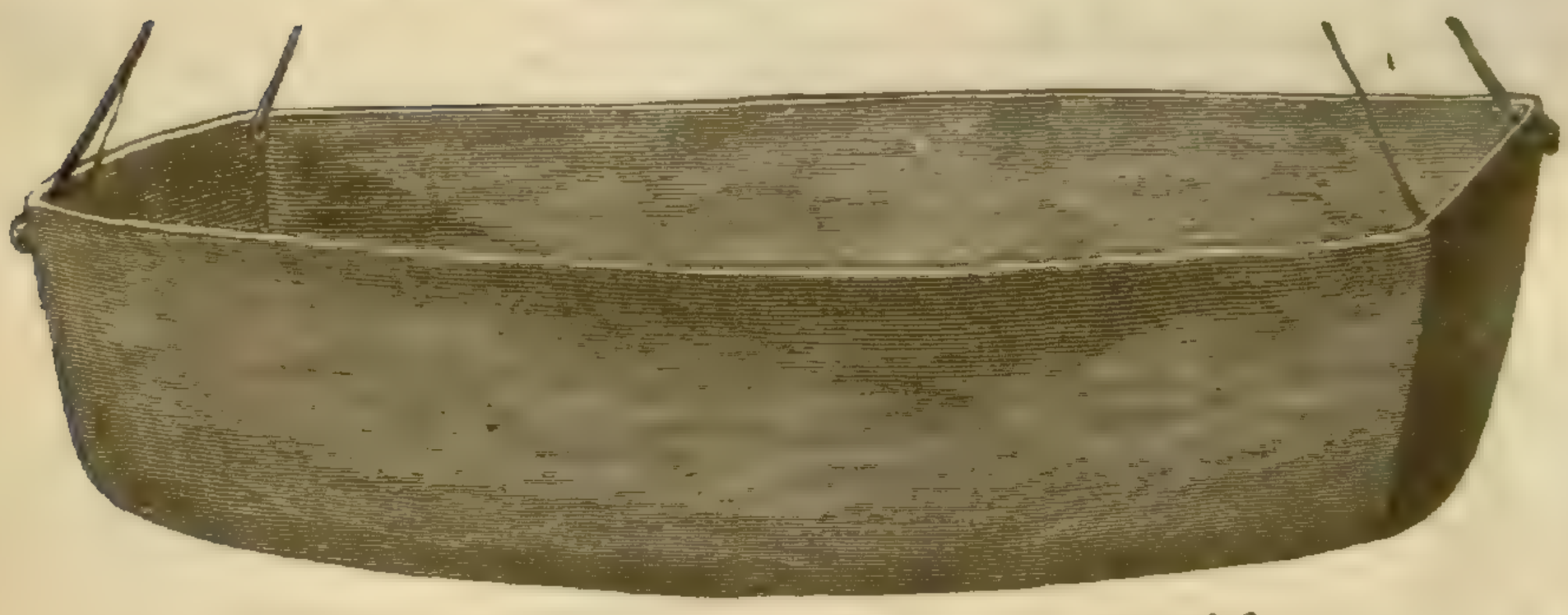


FIG. 3.—Cooking pot of the same material.

The wick of the lamp consists either of fibers of moss or of the dried catkins of the arctic willow; likewise are these latter used as tinder, and are ignited by the sparks produced by the friction of a piece of pyrite and quartz. We also find in use the well known fire drill, the stem of which is placed between an ivory mouth-piece and a fragment of soft wood. By means of the bow the drill is set in rapid motion, which is continued until the dry wood takes fire.

In addition to those above enumerated there are but few utensils: flat dishes made of water-proof sealskin; a few knives, similar to our chopping-knives, and exclusively used by the women; the primitive implements for sewing, and finally, several scrapers of bone, ivory or stone to soften the skins, but the main work in this respect is done with the teeth.

Although the temperature inside the dwellings rarely rises above the freezing-point, the warmth appears almost oppressive to any one entering from without. For this reason adults usually discard their clothing with the exception of the short breechlets, while children frequently are left naked.

Domestic life offers much that is attractive as long as there is no danger of famine. The people are free from care and happy, and all their emotions are mirrored in their expressive counte-

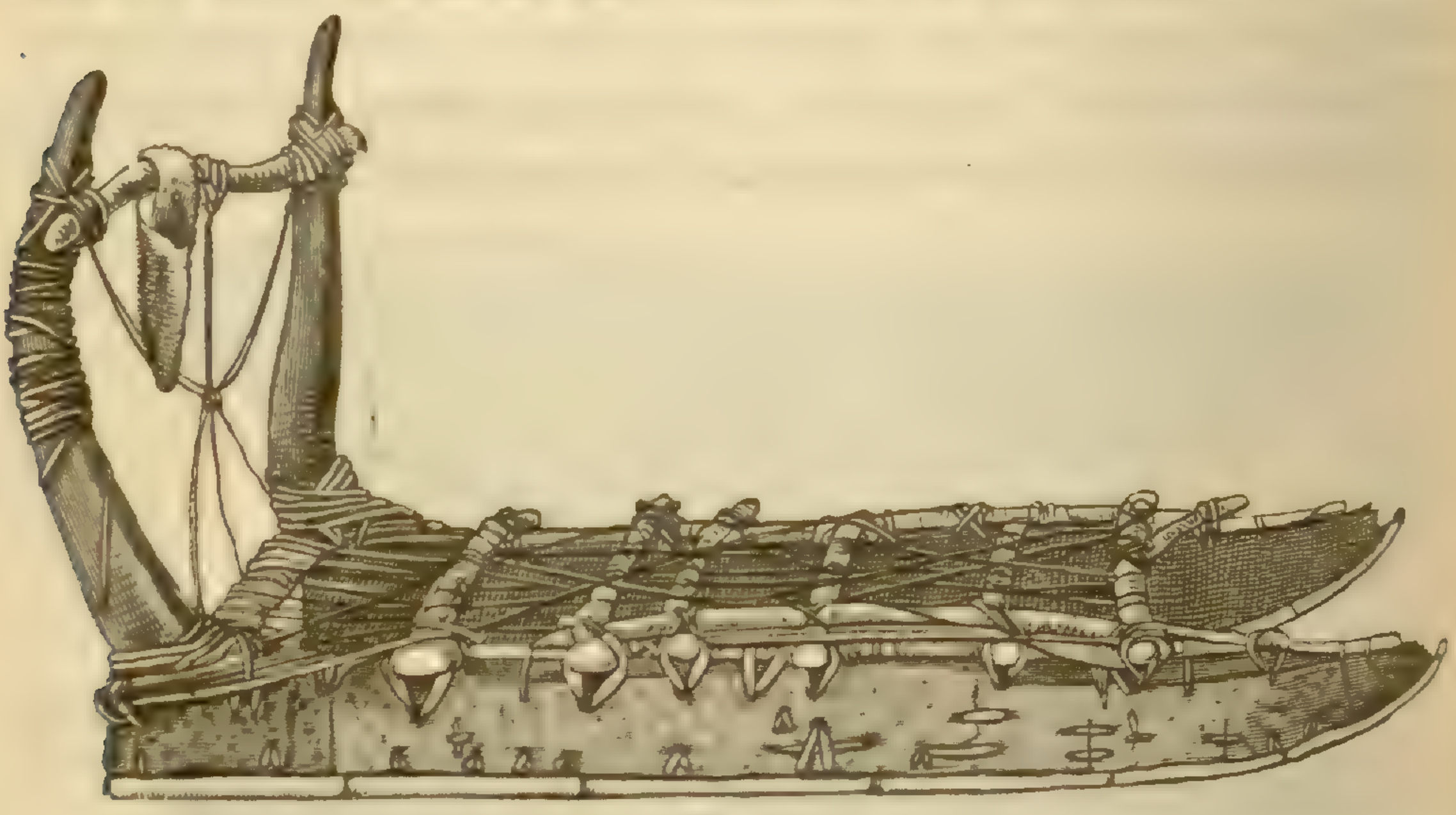


Fig. 4.

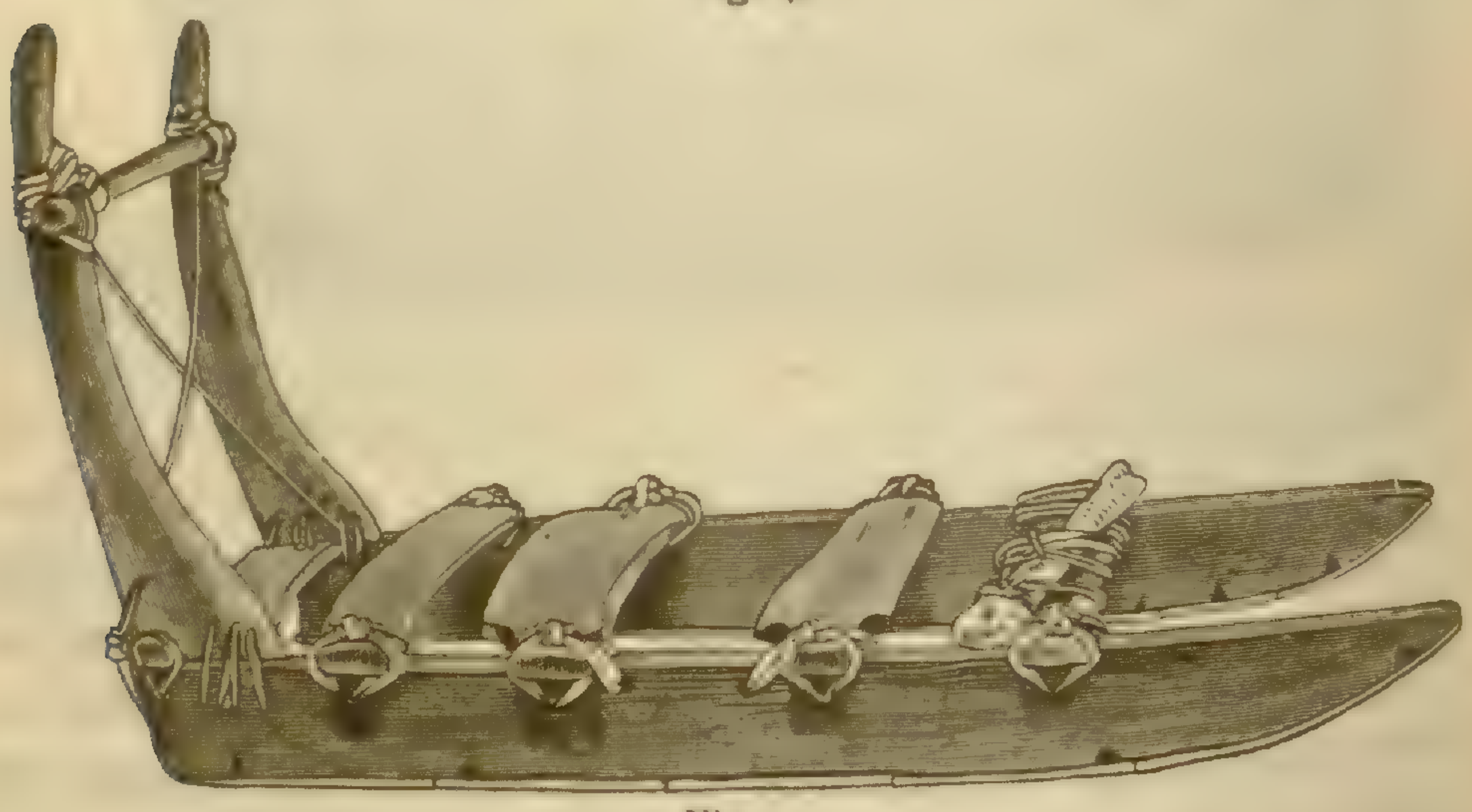


Fig. 5.

nances. Entire freedom from all restrictions and easy deportment constitute the rule.

Nowadays the sledge is the only means of conveyance used by these most northerly people. Before they came in contact with white men this was composed of pieces of bone ingeniously fastened together with thongs of raw hide, but now wood is frequently used. Fig. 4 represents one of these old sleds, copied from Ross, Fig. 5 one made of wood.

The Itanese have neither boats nor bows and arrows, although the words denoting these objects still exist in their language. This is an important circumstance, considering that they are a tribe of hunters, a circumstance indicating decided retrogression. At all other localities we find the Inuit to be brave seamen, developing great dexterity in the management of their frail skin-boats; everywhere else they are excellent archers, and handle the rifle with considerable accuracy in case the latter has replaced the more primitive weapon.

Jimmy, a southern Eskimo whom we found living with the Itanese, was the only one who possessed a bow and arrows, which he had brought from his home. They had frequently been mended, and were in a rather dilapidated condition. The bow was made of four pieces of reindeer horn lashed together with sinew, and was but slightly curved. Its length was thirty-three inches. The bow-string was four ply and made of the cervical ligament of the reindeer. It was fastened around two neatly carved bear-heads at either end of the bow. The arrows, of which he only had three, were provided with iron points. Their shafts were made of splinters of wood lashed together and feathered with raven quills. Including the point their length was from eighten to twenty inches.

The weapons used by them are the lance and the throwing-spear, which is provided with an air bladder, but is used without the throwing-board common to the other Inuit. In addition to these they have a bird-spear.

Together with the figure of a lance (Fig. 6), copied from Ross, I have illustrated another one (Fig. 7), about one-tenth natural size. The shaft of this one is composed of wood. Fig. 8 shows the upper part of the same weapon somewhat larger.

As soon as the lance has reached its aim, the shaft turns over to one side, sliding into its socket from the round base of the lance-head. This ingenious mechanism, illustrating the principle of the ball and socket joint, which could not long remain a secret to hunters, together with the fastening of the shaft-rest, is illustrated by Fig. 9. Fig. 10 represents a shaft-rest more completely finished.

Two detached spear-heads are shown by Figs. 11 and 12. The basal opening of the latter is broken and has been mended with thongs in order to prevent an accidental separation of the head

Fig. 11.

Fig. 12.

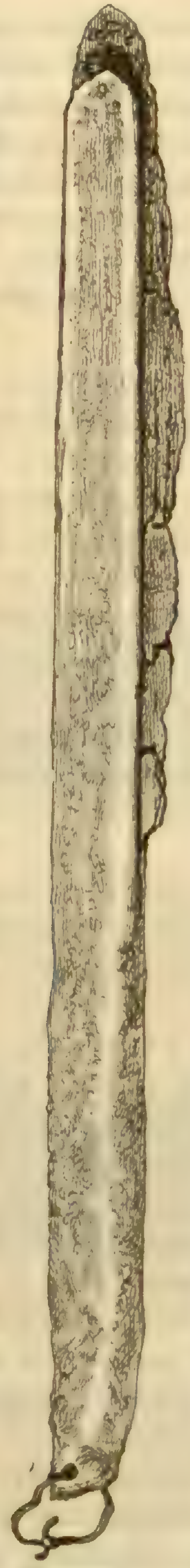


Fig. 12*a*.

Fig. 6.

Fig. 7.

Fig. 8.

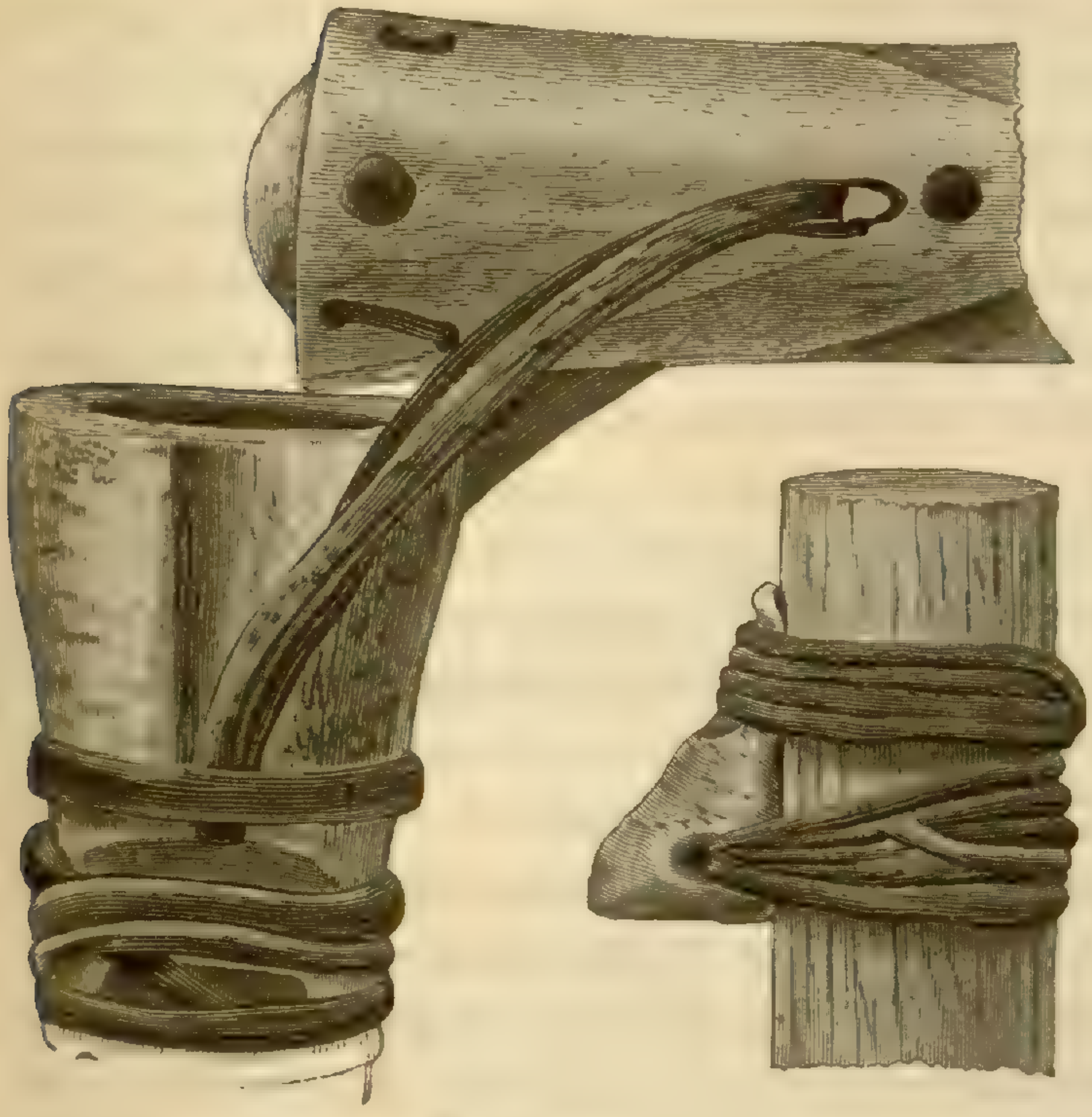


Fig. 9.

Fig. 10.

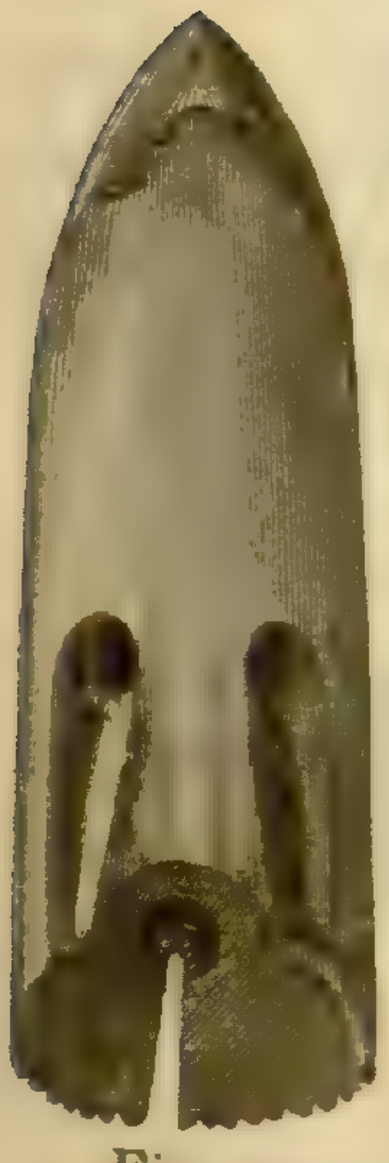


Fig. 13.

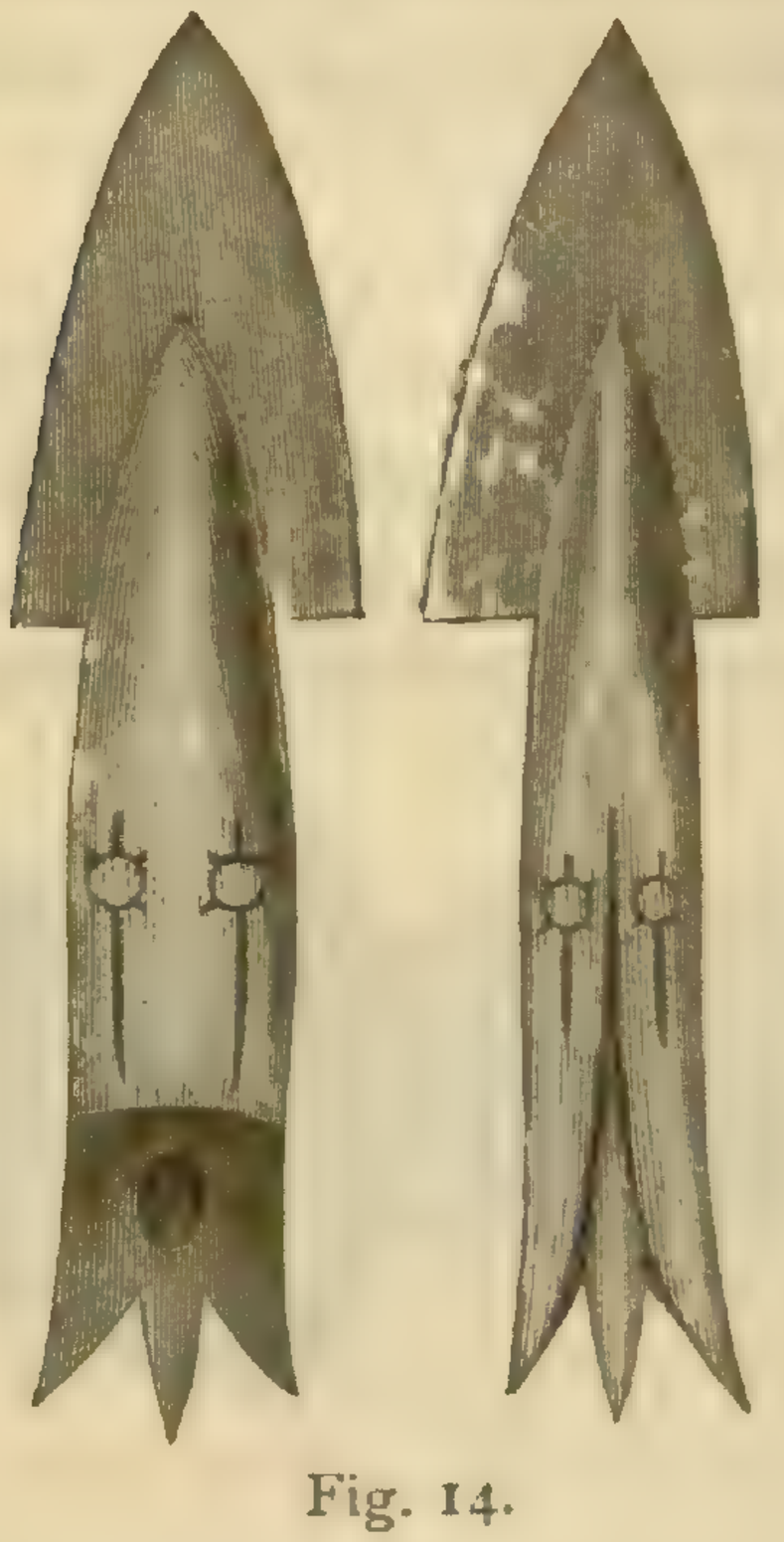


Fig. 14.

Fig. 15.

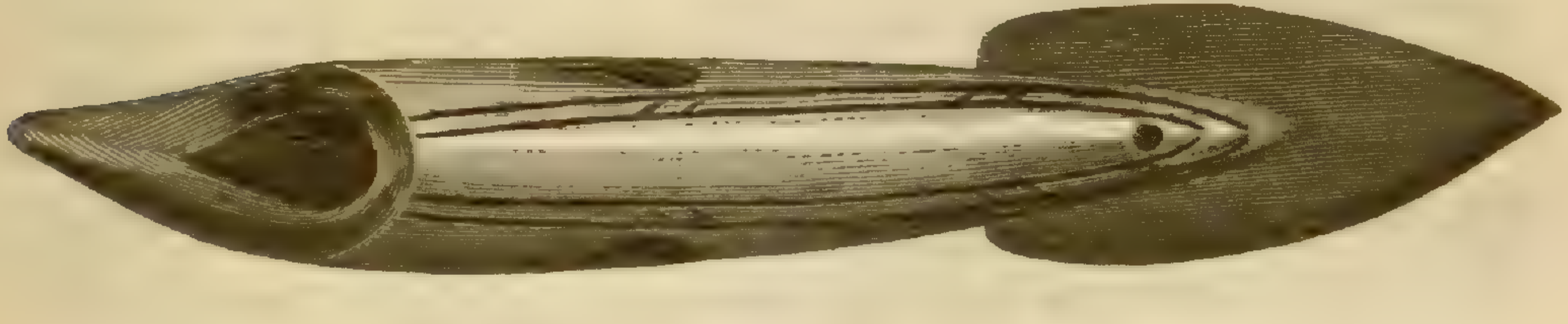


Fig. 16.

from the shaft. In both of these illustrations the long line has been severed near the loop. The first one of these figures shows immediately below the rivet two horizontal grooves, which must be regarded as rude ornamentation. They are similar to the lines observed on many palæolithic implements from the Dordogne, which were generally considered as marks of ownership.

Probably these latter are likewise rude ornaments only. They may perhaps have served to record numerically certain occurrences, as, for instance, the killing of a reindeer, a bear or some other game. It is not a matter of necessity that a primitive people should require special markings to designate their property. It stands to reason that if everyone manufactures his own weapons that these will possess a certain individuality like the handwriting of a person. The power of observation of an Eskimo who accompanied me on a sledge journey was so very acute that he was enabled to distinguish among eleven sledge tracks we came across whose sledge had made each one of the impressions in the hard snow. And this man was by no means more intelligent than his tribal relations. Whoever can discriminate to such an extent will certainly be able to recognize his own weapons without difficulty among others.

Fig. 12*a*, represents a knife, copied from Capt. Ross' narrative. Figs. 13, 14, 15 and 16 are inserted solely for the purpose of showing ornamentations as used by western Eskimos. The illustration of a stone spear-head, taken from an old grave in North Greenland, is here reproduced of two-thirds natural size.

Fig. 17.

With such primitive lances, supported only by their dogs, the Itanese will dauntlessly attack the polar bear, who frequently turns out to be a most disagreeable adversary. Several of the old hunters of the tribe bore on their bodies traces of terrible laceration. They will fearlessly cope with the walrus, will become victors over the huge bearded seal, and will patiently watch

for hours and even days, in spite of cold and drifting snows, at the breathing-holes of the lesser seals.

Whatever is captured by one belongs to the entire community, the skin only is the exclusive property of the successful hunter. With the blubber and meat his own family together with those living in the same hut are first supplied; after that the others receive their shares. As long as the provisions last every table is set.

During the winter the Itanese live exclusively on the meat of the various marine mammals and of bears and foxes, while in summer various species of aquatic birds and their eggs form an important portion of their diet. Fish are obtained only accidentally, the use of the fish-hook being unknown to them. The meat is eaten either raw or boiled, always, however, without the addition of salt. A hunter returning to his home, hungry and weary from his labors, will eat eight or ten pounds of meat without the slightest inconvenience. And indeed he does not regard it as an excessive quantity. With the left hand he grasps a large chunk, stuffs as much into his mouth as possible, and cuts off this huge mouthful immediately in front of the lips. Then he masticates simultaneously on both sides, noisily smacking his lips.

Contrary to the western Eskimo, who frequently have several wives, we find that the Itanese are monogamous. Somewhat communistic tendencies however seriously interfere with the sanctity of marriage.

The average number of children in a family is two. In some emergencies the infants are frequently killed. In some instances the mother will expose her offspring at some isolated place to cold and starvation; in others she will produce death by strangulation. Little regard seems to be had for the sex of the infants.

When one of our native friends died, his wife strangled the youngest of her three children, a boy several months old, and buried him with his father. Two of the *Polaris* crew endeavored to save the little creature. They succeeded in lengthening his life by several hours, but during a short time, while they were not watching the mother, the latter accomplished the deed.

In general the children are treated tenderly; sometimes even with exaggerated affection. Thus we saw a mother who not only carried her boy, six or seven years of age, in her hood on her back, but now and then she even nursed him. Corporal punish-

ment is almost unknown among the Itanese. The little ones grow up like lap-dogs. Once I undertook to give the half-grown boy of one of the hunters a well deserved chastisement, to the great disgust and anger of my good-natured friend, his father.

The only method of punishment that I ever observed was exceedingly original. The squalling babes, scarcely able to walk and totally divested of clothing, were placed on the snow by their

FIG. 18.—Kalutana, the patriarch.

mothers until they stopped crying. And this happened several times when the temperature was more than twenty degrees below zero.

It is a very easy matter to satisfy the demands of the children regarding their amusement. Usually the boys play with small sleds, and after they are a little older practice spear throwing. The girls have dolls carved from ivory or bone and clad with furs, or they have small figures representing animals. Favorite play-

things are young pups, who are tortured with entire disregard to their feelings.

Several of the western Eskimo tribes are in the habit of tattooing their young girls; this, however, is not done by the Itanese. Jimmy's wife, who came from the west, showed a simple pattern of tattooing on her face, and was for that reason often

FIG. 19.—Mother and child.

ridiculed by the other women. At one time I painted the face of a girl about ten years of age with water-colors, which caused her to cry bitterly when she saw herself in a looking-glass. The mother of the child, supposing the color to be permanently fixed, threatened to assault me, and was not satisfied until I washed off the marks.

As soon as the boy has reached his twelfth or fourteenth year he is allowed to accompany the hunters when catching seals, and learns to drive the sledge dogs. After the period of puberty the girls, in their fifteenth or sixteenth year, have already become sufficiently expert to assist their mothers in the preparation of clothing. This together with the propagation of their race are the two main occupations of these northerly women. Their cooking requires but little knowledge, neither do their other domestic duties, except the dressing of the game.

At the time the young man is able to provide for the necessaries of life, he takes unto himself a wife. Generally the marriage is one of love, rarely of convenience. In case the marriage is not ordered by the parents, then the consent of the girl's parents is all that is required. The widely spread ancient custom to apparently abduct the girl of his choice, although she may be perfectly willing, is the rule.

Among the Inuit the communistic mode of life is so pronounced that the dower scarcely comes into consideration. A sledge, a team of dogs and the rude weapons are essentially the total personal property of the man, while the woman owns a lamp, a cooking-pot, a knife and a few needles. In addition to this we may mention the scanty wardrobe.

Under such circumstances the individual physical advantages enter largely into the motive of selection. Added to these are those qualifications which may enable the individual to contend for his existence. Our knowledge at present is not sufficiently advanced to fully enable us to characterize the ideal of physical beauty as conceived by savage tribes. The differentiation of this ideal, however, will necessarily stand in most intimate relation with the division of labor between the sexes. Wherever such division is but slight, there we will find the expression of countenance but slightly differing in man and woman.

As a rule the Eskimo seems to prefer full forms. In how far individual taste may herein be consulted remains to be established. The woman expects the man to be a good hunter, and his endeavor is to obtain a companion possessed of the requisite aptitude to perform her domestic duties.

Although marriage is very easily entered into, it can only be annulled with certain ceremonies. Several of our crew had occasion to witness a divorce:

Manek, one of the young girls of Ita, had been forced by her father to marry Inuk the hunter. But her heart was another's. To him she conceded, after her marriage, the privileges that should have been her husband's, and perhaps those of other married hunters of the tribe. Inuk, driven by jealousy, pursued her with a knife and slightly wounded her side. This determined her father no longer to oppose her affections. In the future Manek was to be the wife of the man she loved. She was divorced from her husband who had been unable to gain her affection. While Inuk was stretched in his hut lamenting his fate and stubbornly refusing meat and drink, Manek underwent the ceremony proper in the hut of a neighbor. With her knees drawn up to her chin she was lying on her back on the bench. Around her head was fastened a leather thong, the end of which one of the oldest women of the tribe held in her hands, murmuring unintelligible words in sing-song tone. She kept steadily pulling at the thong so that Manek's head rose and fell at intervals for more than two hours. Of Manek's relations her brother-in-law was the only witness. After the completion of the ceremony he put the woman on his sledge and took her to a neighboring settlement. Waiting for her she found her lover, who clasped her in his arms and led her to his hut. A few days later Inuk paid us a visit. He was completely reconciled to his loss. When we inquired about his former wife we received the unexpected answer that Manek was a very wicked person.

Shortly after this divorce a burial took place. The corpse was wrapped in furs, placed on a sledge and buried in the snow with its face turned westward. After it had been covered the sledge was placed across the mound and the weapons of the deceased laid beside it. This done the men put plugs of hay in their right nostrils, the women in their left. These plugs were worn for several days and only taken out when entering one of the huts.

Not always, however, are their dead treated in so careless a manner as in this instance. It is true that a regular grave is never made in the frozen soil, but as a rule a hollow mound of stones is erected over the body should frost and deep snow not prevent this.

It is not an easy matter briefly to treat of the religious views of the Itanese, who believe in the immortality of the soul. Other questions also we must refrain from discussing in order not to ex-

ceed the limits of these pages. Whoever desires to become familiar with the legendary treasures of the Eskimo will find ample material for enjoyment in Rink's "Tales and traditions of the Eskimo." The traditions given by him readily prove that the mental power of this primitive people is by no means of an inferior order. Vivid as their imagination is, they endow with genius and life the rigid rock and the soughing wind, the twinkling stars and the flashing aurora, in short, the various astral and telluric phenomena.

Inasmuch as this psychological process involves one of the leading principles of beauty, it may not be without interest briefly to examine in what manner the conception of beauty manifests itself among the Eskimo.

The discussion of this question is rendered the more important if we remember the remarkable similarity between the weapons and utensils of the reindeer period of Europe and those of the Eskimos. Still more importance must be granted considering the fact that the extinct race of Europe existed under analogous circumstances. And we may regard it as an indisputable fact that like causes produce like effects.

At the present time the question whether the engravings and carvings of the Palæolithic period found in Southern France and Switzerland are genuine, has become one of great moment. Since it has been found that some of the Thayingen specimens are counterfeits, the tendency has prevailed to deny the conception of beauty to all so-called primitive people. More particularly does this apply to their ability to depicture animal forms. To the advocates of this view it seems difficult to conceive how a people able only to manufacture rude stone implements could possess the requisite talent to engrave upon horn and bone the figures of animals bearing a certain artistic character both in outline and disposition.

A view like this may partly be justified since, in prehistoric times, the ability to make pictorial representations appeared suddenly and just as suddenly was lost. It remains to be said, however, that up to the present day but a very small number of specimens of this kind have been found, indeed we have just begun to unearth them. The deterioration of this so-called prehistoric art is in itself no matter of surprise, and it is not without a parallel.

That pictorial representation of natural objects has not developed uniformly in the course of time, is an established fact. Do we not find numerous paintings by old masters in which the landscape is crude and totally neglected, while upon the human figures all possible care and attention has been bestowed? Are

FIG. 20.—Interior of a hut.

there not great compositions in existence in which the action of the human figure portrays the innermost secrets of the soul, while the animals associated with them, were it not for their color, would certainly even puzzle a zoölogist?

Whoever considers these circumstances will probably come to the conclusion that the gap between a stone knife and an ornamented piece of bone is not as unsurmountable as it seems.

We need not be surprised to find that the sense of beauty is less developed among the Itanese than among more highly favored southern Eskimo tribes. Wherever the existence of man is hampered by a severe struggle for his physical welfare; wherever the energy of the individual as well as that of the community must solely be directed towards the satisfaction of bodily wants there remains but little time to enjoy beauty of form or to create such.

In spite of all this we find varying ornamentation of the clothing and utilization of differently colored skins and furs which might even satisfy a taste educated in art.

During the winter several of the hunters carved in our presence animals and human figures which were exceedingly characteristic. With very slight means they succeeded in representing the typical physiognomy of the Inuit as well as to express that of the white man. Many of their animal forms were unmistakable.

In spite of all this the talent of the Greenland Eskimo for plastic representation is less developed than that of the western tribes. More particularly among the tribes of Bering strait there are excellent carvers in ivory whose productions, in some instances however, clearly show the influence of the neighboring Indians. To investigate the degree to which one primitive people may in this respect be influenced by another would be a work of no little interest.

The National Museum of the United States contains numerous carvings of these north-western Indian tribes. Among many specimens which may be considered as barbaric, are some sufficiently good to claim our attention. Whoever has had occasion to observe the expressive countenances of the wooden statuettes No. 713 and 714, representing Indian figures, would certainly not be tempted to consider the "browsing reindeer" an extraordinary production.

An ivory torso exhumed by Dr. Hayes from an old grave in the vicinity of Ita, is the subject of the appended illustration. It is a matter of regret that the annexed wood-cut does not do full credit to the subject. The original, as seen from the left, shows a very pretty side view, the back is totally devoid of detail; in the vicinity of the hips, however, and in the lower extremities the anatomical form has been well reproduced. Fig. 21.

After I had myself made a series of experiments in carving

ivory with stone and metal, I came to the conclusion that the above-mentioned torso was not produced by means of stone implements.

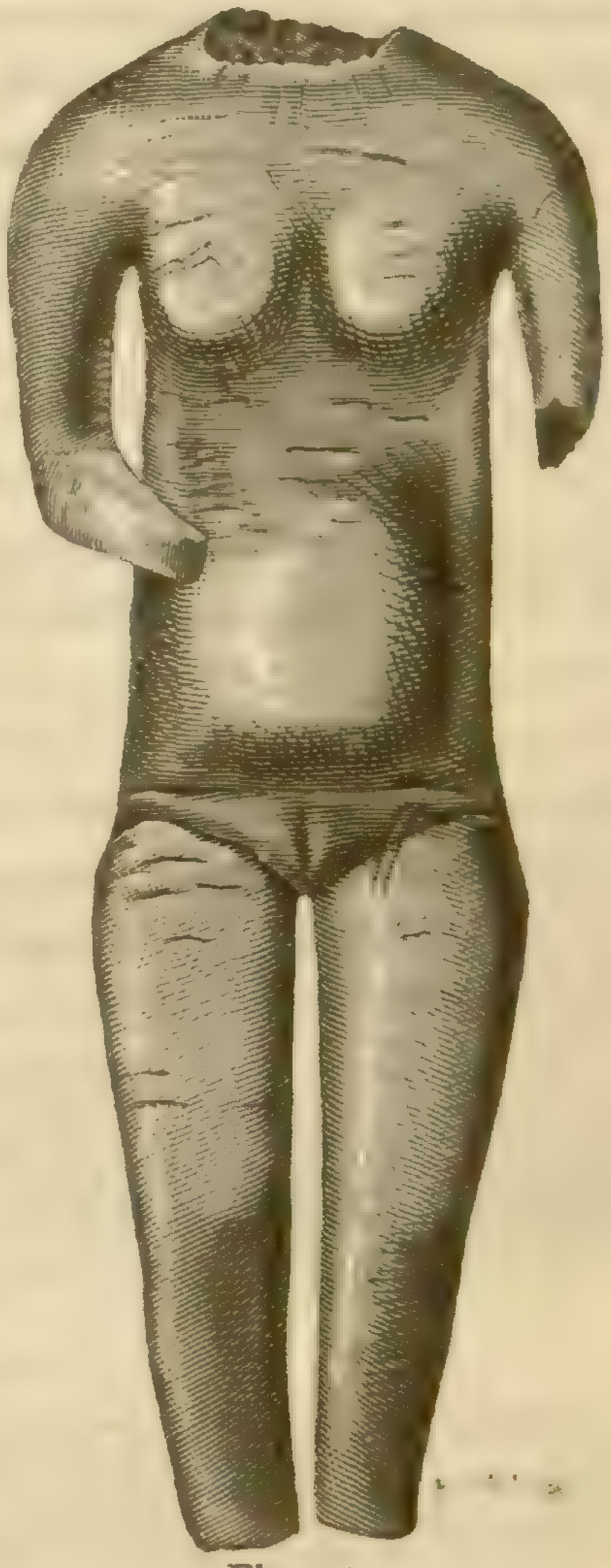


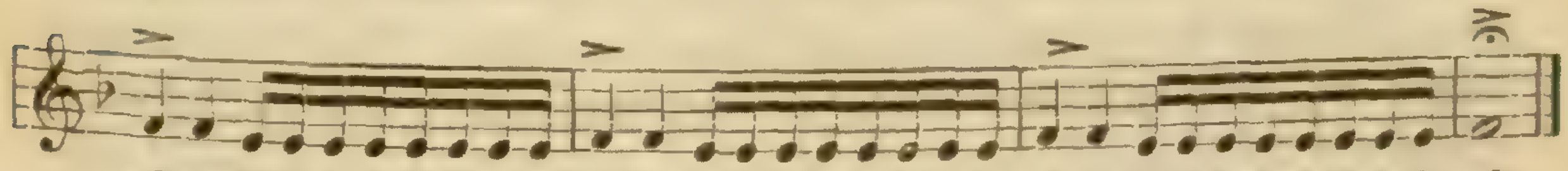
Fig. 21.

It would be reasonable to suppose that among a nation of hunters who possess any appreciation of music, at the same time using bow and arrows, we should find primitive stringed instruments. The incentive to the construction of the latter would be given by the twang of the bow-string.

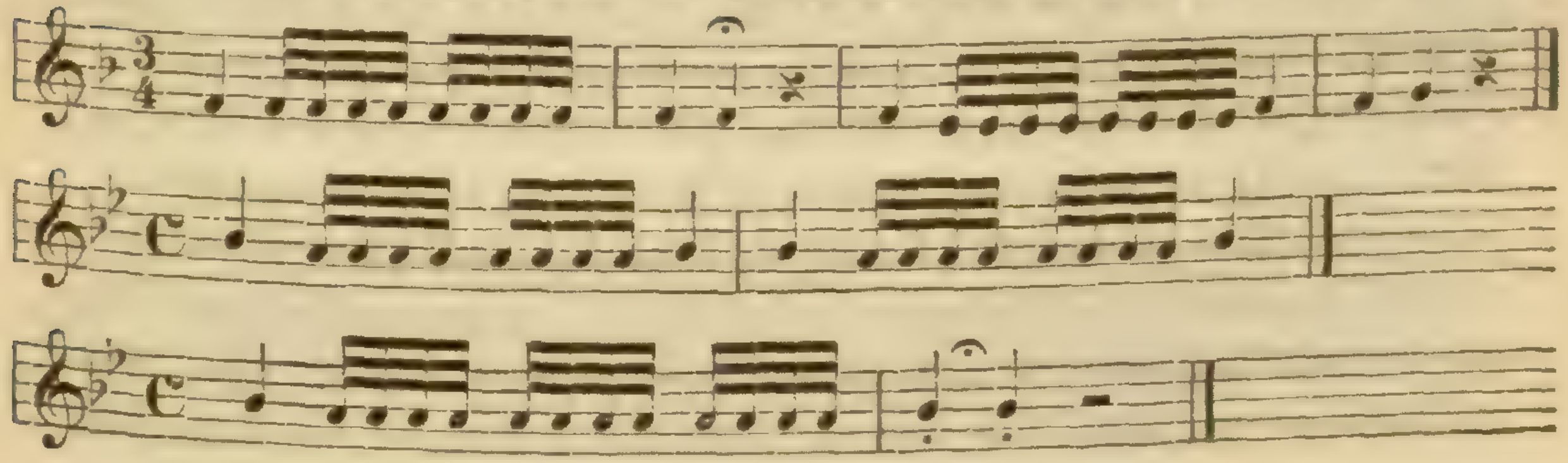
None of the Eskimo tribes, however, which make use of this weapon, possess instruments of such character. The drum, made of a rude bone hoop covered with an elastic skin, was the only musical instrument found. Commonly a femur of a walrus or seal is used as a drum-stick.

But little is to be said in favor of the music of the Itanese. At irregular intervals he mercilessly pounds his instrument, moving the upper portion of his body to the right and then to the left, singing a tune which lazily proceeds with slight gradations upon a slightly varying key-note.

The following may give some idea of the character of this song:



ah ja ja ja ja ja ja ja ja ja ja ah ja ja ja ja ja ja ja ja ja ja ah ja ja ja ja ja ja ja ja ja ja ah.



It must be stated, however, that this reproduction is correct in part only, because many of the intervals amount to less than a semitone, and cannot therefore be expressed by the customary system of musical notation.

Among the Eskimos near Bering strait the intonation is very similar. A sergeant of the U. S. Army who was stationed near Norton sound, repeated the songs to me. Even the senseless text is the same with the exception that the *a* in *ah ja* is more like a^n: with other words it is entirely nasal. It seems that in former times the southern Greenlanders had a similar song. The well-known Eskimo Joe sang for me a series of notes the shades of which could doubtless be analyzed with the aid of a series of Hemholtz's resonators. Parry furnishes in his "Second voyage for the discovery of a Northwest passage" (p. 542), the song of the inhabitants of Winter island. Although decidedly lugubrious some of these phrases nevertheless move over two and a half intervals. The text is *Amna Aya Aya Amna ah*, similar to that of the Itanese and the other inhabitants of Greenland.

From these brief remarks it may be seen that the Inuit from West Greenland to the shores of Bering strait possess a common ancient song, a song which in the course of time has undergone less modification than even their language.

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OPINIONS UPON CLAY STONES AND CONCRETIONS

BY L. P. GRATACAP.

CLAY dogs, clay stones or clay concretions are terms indifferently applied to a singular class of objects which occur in clay beds of recent or Quaternary age, in spots where conditions favorable for their development have existed. They certainly strike the eye as remarkable in their curious mimicry of the shapes of birds and beasts, and in the capricious complexity of their forms. The question inevitably provoked by them: How were they made? has received an answer of a generic character, including under one process the phenomena of spherulites in lava, septaria in iron ores, flints in chalk, nodules in sandstone, peastone in limestones, the hexagonal columns of basalt, the structure of granite boulders, geodes of quartz, segregations of iron pyrites and the simple and complicated shapes shown upon the accompanying plates, viz., by *concretionary action*. Concretionary

action has been assumed to indicate a cohesive and attractive property in matter when finely divided, and when its particles possess some or considerable freedom of motion, whereby molecules of the same sort gather together in bunches or globes. sometimes coat over coat, the whole enlarging until the limit of cohesive action around that center has been reached, or the expanding circumference of one concretion meets and impinges upon its growing neighbors in a mass affected throughout by this "toward-a-center" movement. This is a partial confession of ignorance as to what the essential nature of the process is. We are led to believe from the analogy in all these cases enumerated above, that the action is the same, and perhaps it is, but modified by varying conditions and the constitution of the substance influenced.

It is doubted whether basaltic columns can ascribe their formation to concretionary action, and it is plainly stated that geodes arise from the entrance of saturated solutions from without, through fissures, into the cavities formed within clay or other nodules, by internal shrinkage, of which process the familiar hollow iron ore balls are a good illustration.

The authorities are not inclined to throw much light upon this curious phenomenon, regarding it as an ultimate fact in nature. Dana gives no explanation of this process (Manual, 1879, pp. 85, 86, 87, 88) but illustrates it in various figures. In the Manual, 1875, he speaks of concretions "having the form of, or containing spheroidal concretions; some varieties are also called globuliferous when the concretions are isolated globules and evenly distributed through the texture of a rock; others are oölitic when made of an aggregation of minute concretions not larger than the roe of a fish." He speaks of one example as "a crystalline rock with spherical concretions imbedded in its mass and not separable from it * * * each layer (of the three forming each concretion) consisting of different minerals, for example, garnets the center, feldspar the middle layer and mica the outer, and all making a solid mass. The constitution of such concretions is very various. In rocks containing feldspar they usually consist largely of feldspar and sometimes of feldspar alone or of feldspar with some quartz. The concretions in pitchstone and pearlstone (called spherulites) are almost purely feldspathic, and often separate easily from the rock." He figures

concretions in sandstone, and one notable one where in the
lets included between the cracks of an argillaceous
concretions have formed, bounded by the polygonal
cell. Unfortunately there is no word said as to the nature
concretion, whether entirely like the rest of the rock, nor
the entire sandstone partakes of this nature. He also
crystallized bunches of quartz and pyrite as instances of
tionary action, remarking that "this tendency in nature
centric solidification is so strong that no foreign
needed."

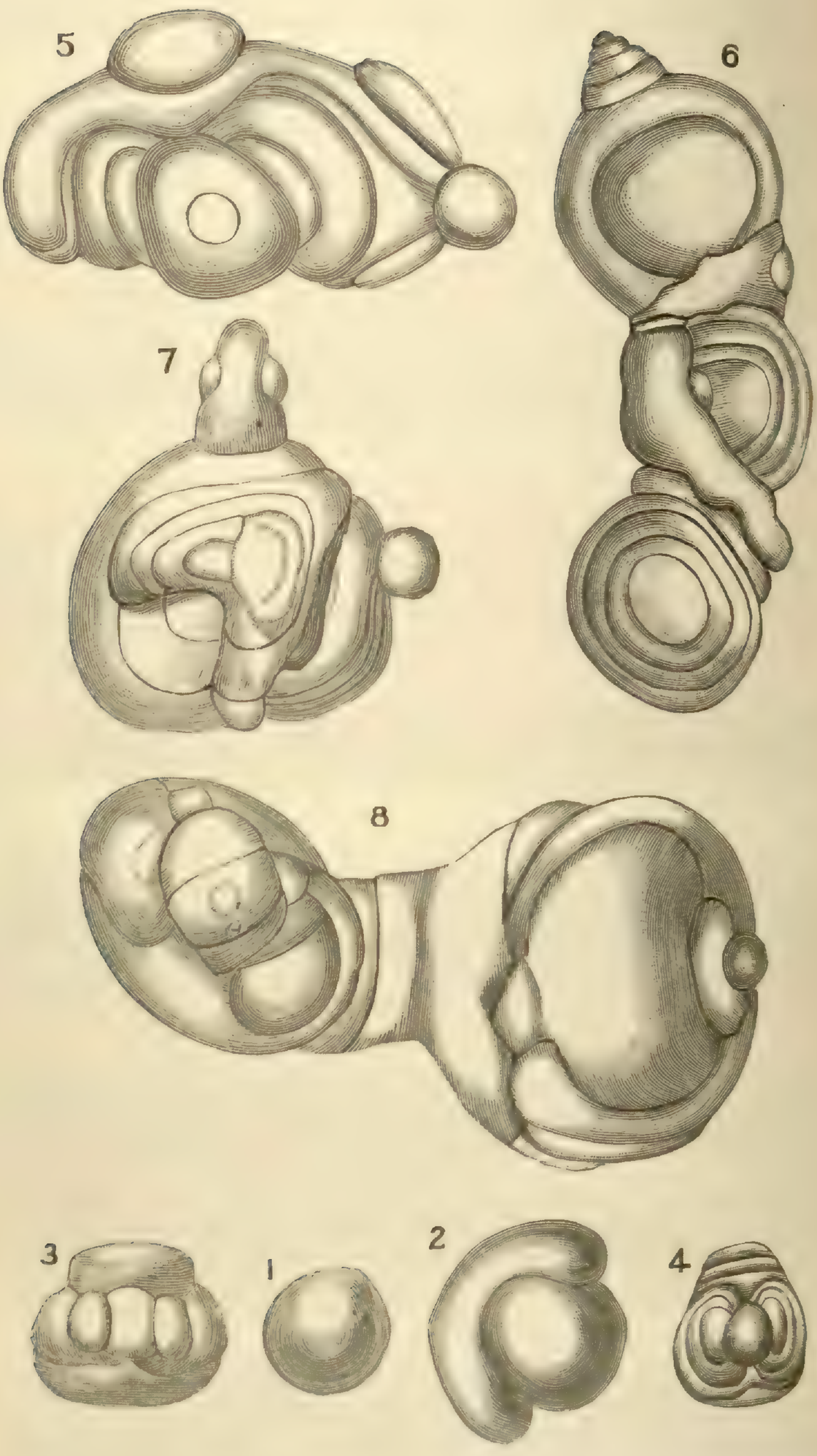
In the Text Book for 1883 he says much the same
abbreviated form, referring with more doubt to the concre
character of basaltic columns, but defining the process
result from a tendency in matter to concrete or solidify
centers."

Le Conte, in his Manual of Geology, devotes three pa
concretions, explaining them as occurring "whenever
stance is diffused in small quantities through a mass of
different material. Thus if a stratum of sandstone or
small quantities of carbonate of lime or carbonate of iron
through it, the diffused particles of lime or iron will
a process little understood, segregate themselves into
less spherical or nodular masses, in some cases almost
generally inclosing a considerable quantity of the
strata. In this manner lime balls and iron ore balls and
so common in sandstones and clays, are formed. In
the flint nodules of the chalk were formed by the
silica, originally diffused in small quantities through the
sediment. Very often some foreign substance forms the
about which the segregation commences."

Dr. Dawson, in a note upon cone in cone structures
Acadian Geology, says of ordinary concretions, "they
general attributed to the mutual attraction of particles
through masses of sediment and aggregating themselves
solid bodies as nuclei, or flowing into cavities of fossils
places of least resistance."

Professor A. H. Green, in his Manual of Geology, says,
ing of laboratory concretions in chemical solutions and
tates: "That nodules are being formed in the same way in
rocks now in the course of deposition. It is usual to

PLATE XXVI.



this process as concretionary action. There is no objection to be raised to this phrase, and it or some similar term may be safely and conveniently used to express the fact that certain matters have been separated out of the body of the rock and collected together in balls, provided always we bear carefully in mind that by giving the process a name we do not get any nearer to understanding the manner in which the result has been brought about. If any one asks us what made the nodules, we may, if we like, say concretionary action; but if the awkward question is put, What is concretionary action? we should be somewhat puzzled for an answer. We know that one of the ingredients of a mixture has been extracted from the surroundings and gathered into lumps; how exactly this was done we do not know. The term, in fact, is only a way of stating our ignorance, and, unless due precaution be taken, a somewhat dangerous way, because to certain minds it looks like an explanation."

This remark of Professor Green echoes the German couplet:

> "Denn eben wo Begriffe fehlen
> Da stellt ein Wort zur rechten Zeit sich ein."

Archibald Geikie says (Text Book of Geology): "Concretionary, containing or consisting of mineral matter which has been collected either from the surrounding rock, or from without, round some center so as to form a nodule or irregularly shaped lump. This aggregation of material is of frequent occurrence among water-formed rocks where it may be often observed to have taken place round some organic center such as leaves, cones, shell-fish remains or other relics of plants or animals. Among the most frequent minerals found in concretionary forms as constituents of rocks are calcite, siderite, pyrite, marcasite and various forms of silica. In a true concretion the material at the center has been deposited first and has increased by additions from without, either during the formation of the enclosing rock or by subsequent concentration and aggregation. Where, on the other hand, cavities and fissures have been filled up by the deposition of materials on their walls and gradual growth inward, the result is known as a secretion."

M. Virlet, on the 20th January, 1845, presented to the Geological Society of France, a paper upon this subject, in which he claimed that concretionary masses had been formed subsequently to the deposition of the rocks or layers in which they were found,

by a molecular displacement, the particles of the concreting substance being gathered together by some action similar to electrical action. The paper elicited from M. Becquerel assent in the following words: "A mass of geological facts adequately show that there has been and is yet, in different rocks, centers of action around which foreign substances and their compounds gather. There is no doubt that these transferences of molecules may have been effected by forces analogous to electricity, but it is not sufficient to suppose that the phenomenon has an electrical origin, it is necessary to prove it; this is what I have already done in a certain number of cases by reproducing these compounds," &c.

M. Virlet, in the same paper, compiles a chronological statement of the views held by geologists and chemists previous to his own publication, from which the following notes are taken.

In 1816 Mr. Buckland speaking of nodular siliceous beds and the flints of chalk, says they seem to have been formed whilst the material which encases them was yet soft, and to have reached their hard or solid condition almost contemporaneously. The separation of the silica from the calcareous mass would have been achieved through the attractive forces which drew the siliceous particles towards certain centers. In 1834 M. de La Beche remarks, "that we see in the rocks of mechanical origin certain very remarkable aggregations which must have been produced by the mutual attraction of the molecules which compose them." He remarks that these nodules contain more carbonate of lime than the marls and argillaceous schists which surround them, and in allusion to their laminated character says, "that we can scarcely doubt that they have been formerly the continuation, one of the others. The molecules of calcareous matter have separated themselves from the marls to unite as we now see them, and we would not probably be mistaken greatly if we assumed that the beds of the particular deposit, without containing sufficient carbonate of lime to form successive beds, contain nevertheless too much of it to remain disseminated in the marls without being gathered into small masses."

Mr. Babbage showed that siliceous particles form concretionary-like bodies in the clay preparations used in the manufacture of porcelain. M. Virlet objects to the finding of any analogy in the two cases, as the pottery mass has been formed at once and the natural beds have been deposited slowly over long periods.

Sedgewick considered concretions very interesting, inasmuch as they indicate that the determining causes are due to some débris, either animal or plant, or some small invisible grain which he remarks is in accord with what experience has taught us in the precipitation and crystallization of salts, which ordinarily are determined by the presence of foreign bodies in the midst of a saturated solution. The same action, as seen in the formation of calculi in the bladder, he discerns in nature, and regards the presence of strange bodies as formative of concretionary centers, where the material separated from the different beds has gathered together. The principle of all this he suggests may be bound up in the assertion that like seeks like.

M. Turpin, speaking of siliceous concretions in the chalk, says if we admit that the nodules of flint owe their transformation to the decomposition of innumerable plants or animals, which live either in salt or fresh water, and upon these marine or lacustrine floors the débris or the entire bodies of these beings fall and pile themselves up upon each other, so as to form great beds, more or less thick, made up of everything, if we recall that these animals are made up in great part, first, living organic matter, second, calcareous material, third, silica, these two last having been absorbed and secreted molecularly and confusedly in the interstices of the first; if, in this pasty bed, gelatinous and very liquid, that we may call *barégine*, a bed where all is mixed, we admit, as appears proven, the separation, more or less complete, of siliceous particles, and the conglomeration of the first amidst the second, as the globules of blood and those of milk, for sake of comparison, separate from the serum to form clots, we can imagine that any natural object, organic particle, &c., might form the center of their concretionary growth or be enveloped in their outward extension. M. Virlet thinks M. Turpin proves too much, and that if such an attraction were universally so, clay beds or siliceous limestones would not be homogeneous but form themselves into beds of nodules of silica and lime.

Lyell, in his Elements of Geology, thinks that the molecules were held in suspension in water; once deposited, those which have a similar nature appear to exercise mutual attraction upon each other and gather in certain spots, where they form heaps, nodules and concretions. He instances the celebrated beds of magnesian limestone in the north of England, where the size of

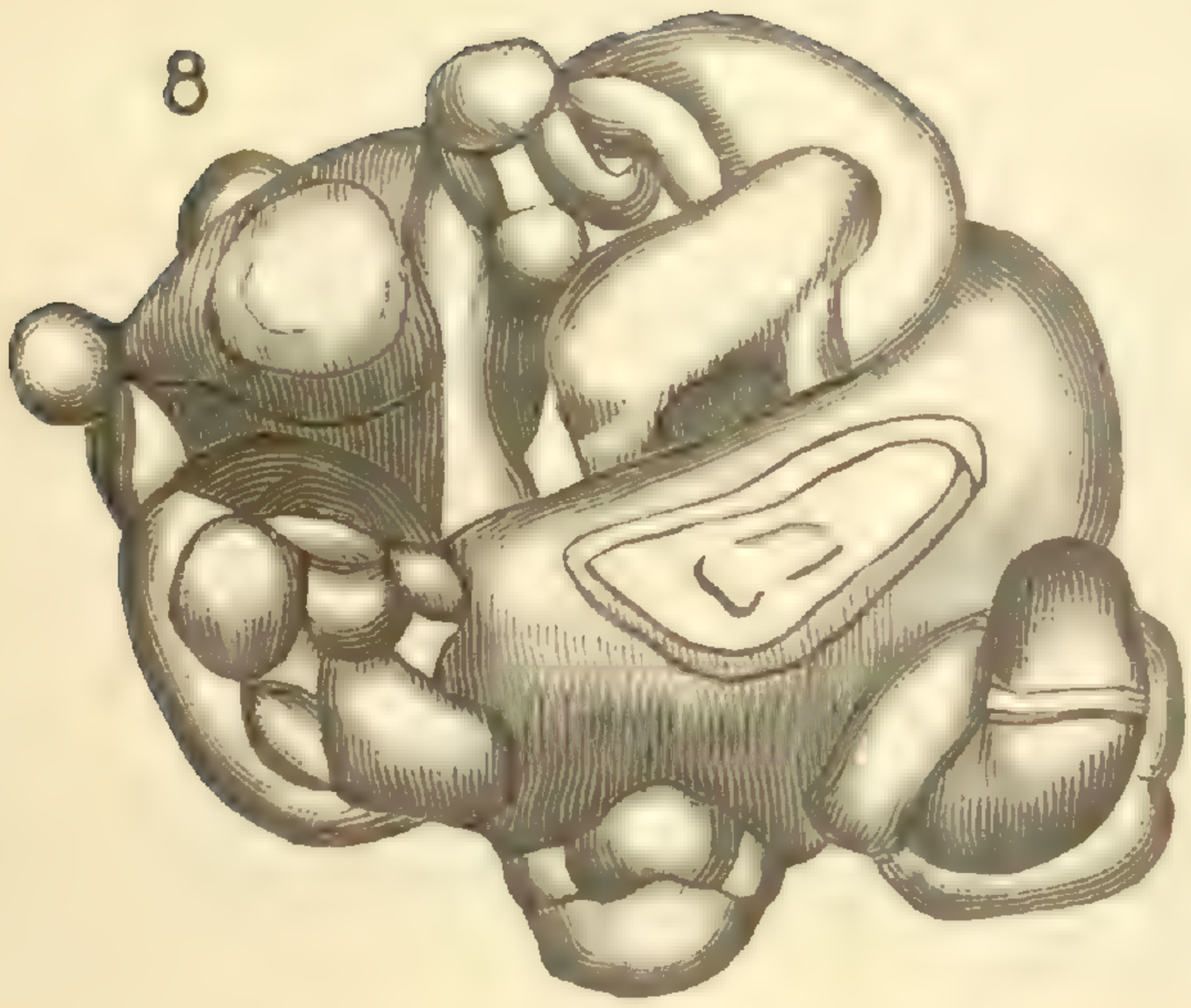
the spherical concretions greatly varies from that of a pea to those many feet in diameter, while they are intersected by the laminæ of the original deposit.

The stones of Imatra, which have attracted much attention and are like our clay dogs, have been studied by M. Parrot, who has ventured to classify the irregular shapes under the names of monotypes, ditypes, tritypes, tetratypes, pentatypes and polytypes. Hypotheses to explain these have been various; first comes the gyration theory, which is inadmissible; the stalactitic theory explains them by infiltration, the vegetable theory regards them as fossil toadstools, another theory considers them as coprolites, the animal theory, which M. Parrot defends, considers them as the remains of petrified animals similar to Medusæ.

Bowerbank and Parkinson attributed many flints to a coralloid origin as being alcyonaria which had attracted silex and had been covered with a gray crust presenting no trace of organization, and that they had then been penetrated by chalcedonic flint, red or purple, which had replaced the molecules of the animal matter as it decomposed.

In Vol. IV, 2d series, Transactions Geological Society of London, Dr. Fitton, in his paper upon the strata below the chalk, says, "all stages of gradation can be perceived from distinctly separated concretions of stone to others so nearly uninterrupted that the next step into perfect continuity can be easily conceived:" again he writes, "in all these cases the concretions must have been formed after the deposition of the sand which includes them, and probably beneath a great depth of compacted materials. In such a mass, shut off from the free access of air and change of temperature, there is no obvious reason for disturbance of affinities which maintained the original form of the components, except the decomposition of the animal and vegetable remains diffused among the stony substances, yet here we have not only solid limestone, where nothing but loose sand and gravel were before, but firm siliceous concretions pervading, and so identified with the separated particles of the quartzose sand that the whole is nearly homogeneous. If the decomposition of the organized substances, continually acting throughout very long periods of time be not sufficient to produce the whole of these effects, perhaps it may be supposed that electricity is the cause which sets free the elements and disposes them anew."

PLATE XXVII.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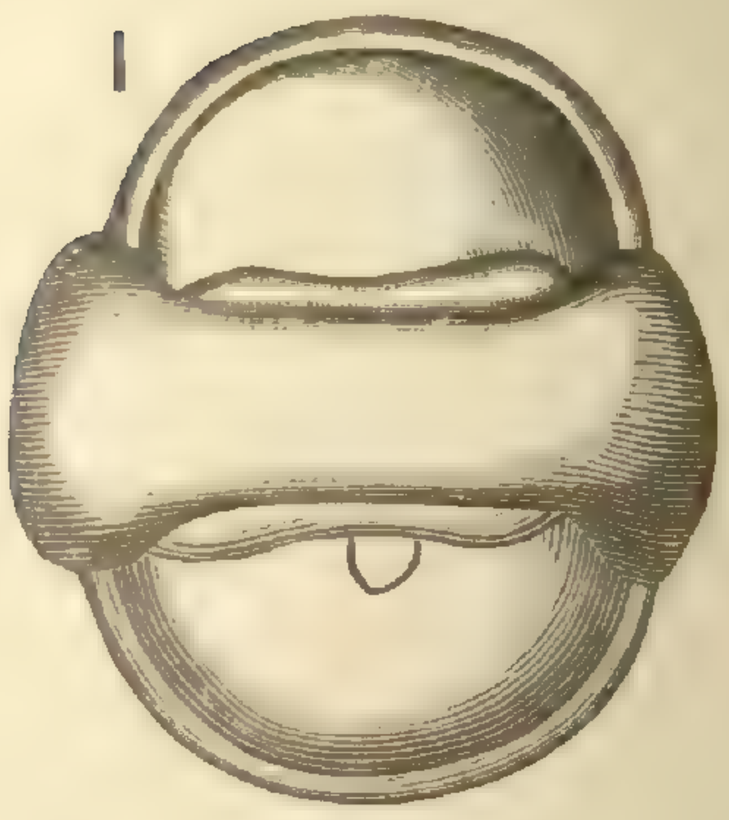
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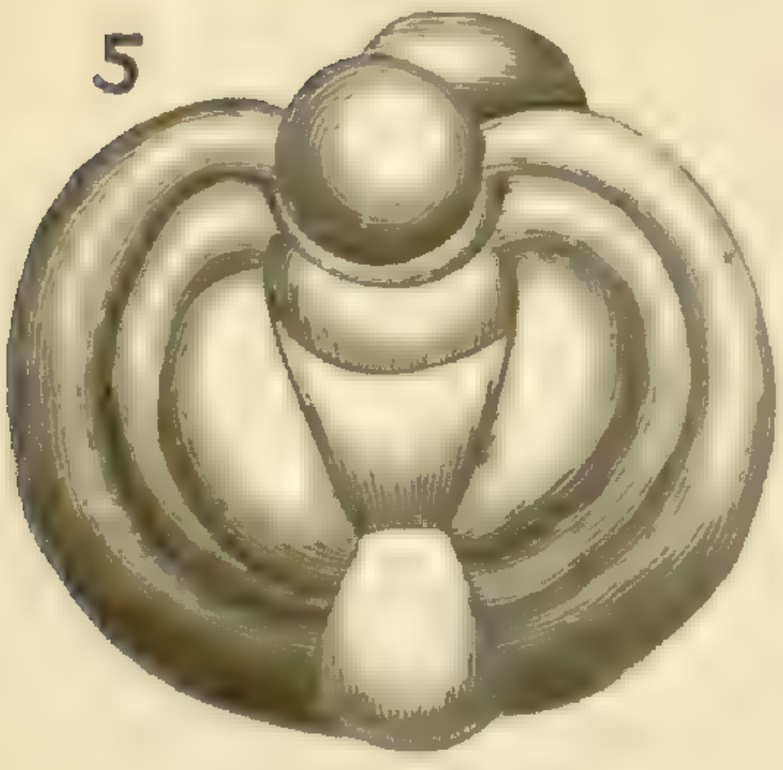
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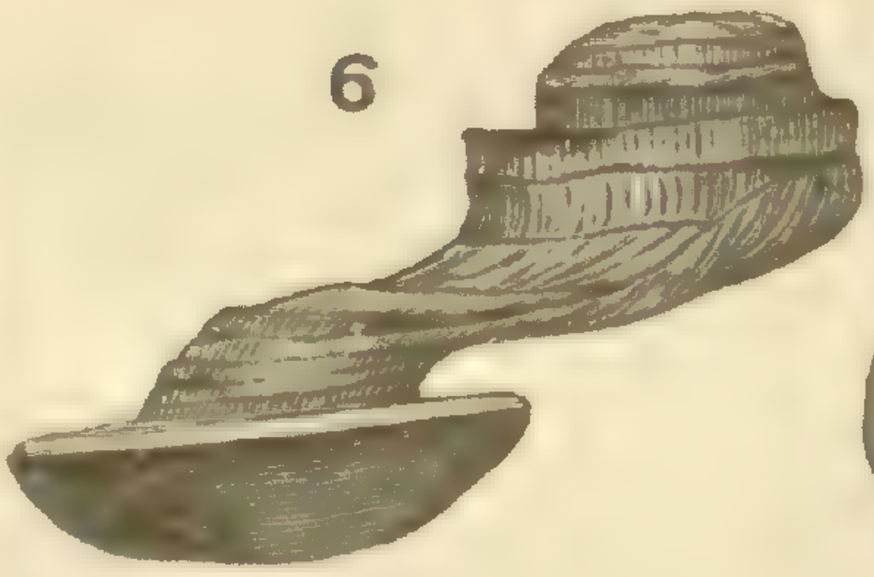
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In the special instances of concretions known as clay stones—carbonate of lime, clay, sand and iron—two writers have treated of them at considerable length. Parrot, in the Memoirs of the Academy Sciences St. Petersburg, Vol. v, 6th series, gives a very extended examination of the stones of Imatra, which ends very inconclusively with assigning them to an organic origin. His figures are very interesting, and differ considerably from the familiar forms of the Connecticut valley.

Professor Hitchcock, in the Geology of Massachusetts, devotes considerable time to them, and his remarks are most important. He considers them as formed by the crystallization of calcite in clay, that lateral accretion predominates, from the easier movement in the clay particles sideways, that different localities have different forms, and that they are laminated by growth from segregation in successive layers of the clay bed. He seldom finds nuclei.

The writer's examination of a collection of these objects seems to warrant the following conclusions:

1st. That in their formation they have passed through a preliminary or soft stage, before hardening, more or less long (Pl. XXVI, Fig. 7; Pl. XXVII, Fig. 1).

2d. That the process of a concretion has formed a center about which others gathered; has, as it were, precipitated and induced more extended action of the same sort (Pl. XXVI, Fig. 5).

3d. That the approach to solidity of a concreting mass is attended with a development of new centers around which concretions form (Pl. XXVII, Figs. 7-8).

4th. That the tendency of matter is to concrete around a center from all sides equally, but that if there is deficiency of material, on the side where the material is plentiful, the form will correspond (Pl. XXVI, Figs. 2, 5, 6).

5th. That concretions lie parallel to the bedding, are flattened vertically, are wider than high (Pls. XXVI, XXVII).

6th. That the upper surfaces are varied and in relief, while the bottoms are apt to be flat (Pl. XXVII, Fig. 8).

7th. That the concretion is often plainly built upwards by the superimposition of many films (Pl. XXVII, Figs. 2, 3, 6).

8th. That the amount of carbonate of lime varies: according to Hitchcock, 43 per cent to 56 per cent; Parrot 51 per cent to 55 per cent; Swedish, 60 per cent to 61 per cent; the writer, 45.63 per cent.

9th. That the concretions vary in specific gravity: Parrot, 2.5, 2.49, 2.54, 3.34; the writer, 2.60, 2.57, 2.67, 2.59.

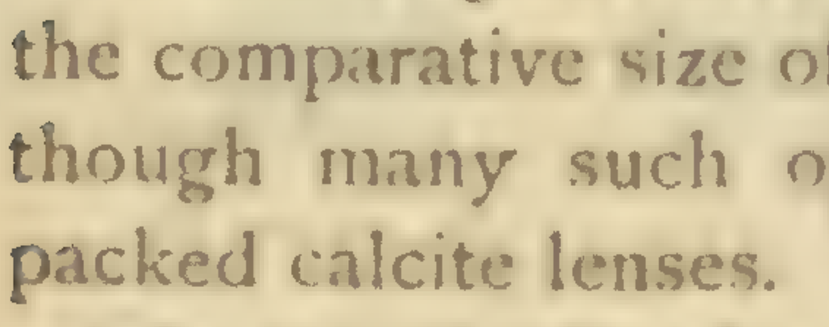
10th. That many show periods of growth (Pl. XXVI, Figs. 4, 6; Pl. XXVII, Fig. 5).

Further, the results of microscopic examination have been these: A horizontal, equatorial section of an oblate concretion, when examined with an one-eighth objective, showed an area densely crowded with crystalline points of calcite, so closely packed as to resemble a patchwork of fine mosaic, of which the separate pieces varied in *apparent* size from $\frac{1}{4}$ to $\frac{1}{2}$mm. This was seen in polarized light. No apparent variation in their number between the center and circumference of the disk was noted, but there were evident crowds or congeries of these shining specks in places, though usually their distribution was uniform.

Between crossed Nichols irregular and loosely connected dark blotches or clouds appeared over the field between which, in the lacunæ, shone transparent plates of calcite varying in size. Black lines in labyrinthine reticulations seemed to outline the calcite crystals, the latter lying in their meshes.

A cross vertical section revealed no linear arrangement of calcite crystals, and in the slide in question the minute tesselation of the horizontal section was repeated upon a possibly denser and more microscopic scale, whilst between crossed Nichols the spots, loops and blotches of clay became very noticeable.

A horizontal section through a group of three concretions showed the subjoined outlines, when a plane surface was ground for its attachment to the glass, the outlines of the two side concretions being very faint.



The section presented, under the microscope, no differing features from those examined before, unless the groupings of calcite specks were slightly more marked. The clay lines seemed larger and more meshy, like a net. On removing the calcite with hydrochloric acid the clay remaining on the slide presented a surface of perforations. The apertures varied in size, indicating the comparative size of the calcite crystals removed by the acid, though many such openings were previously filled up with packed calcite lenses. Sometimes the holes left by the removed calcite were inclined tubes, and the fenestration was like a bryozoan surface. The acid washed on the thin film though quite

strong, did not entirely remove the calcite, it lingered still, entrapped in the clay particles.

The assumption which may combine these features and accords with microscopic examination seems to be this: That in the clay beds where these dogs occur there were variously shaped spots or irregular separations between layers where moisture remained for a long time, keeping the clay in a plastic, more or less liquid form, and that with the withdrawal of water to these points, the soluble carbonate of lime was also gathered there. This latter became concentrated by the contraction of the magma, or through introduction of more carbonate of lime in solution in percolating waters.

Upon concentration the carbonate of lime crystallizes within the mass and one crystal speck thus appearing would form a center of growth around which the new crystals would gather, drawing in clay with them. If this action occurred in a narrow seam-like plane the concretions would be flat, if in a wider area more spherical Sphericity of growth seems an ultimate principle, but contraction of space and thinness of the concreting layer for the most part causes the concretions to expand symmetrically all around.

Where spots of this character coincide one over the other in rising layers of the clay beds, a pillar is formed, where they connect obliquely a slanting pile of disks is made (Pl. XXVII, Fig. 6). As the material in one of these areas becomes consolidated, we may suppose the upper surface to become denser and crystallization beginning at a number of points the surface is broken up in a number of separate forms. Thus the small wart-like bodies would seem to have formed quickly and to have become fixed at once.

This growth may have been quite gradual or quite rapid, but in all cases due to the concentration of the calcite solution in the clay magma and then its crystallization. It could have been interrupted, irregular, more on one side than another, two or three or more concretions may have originated at the same time and grown towards each other, or interfered and enveloped each other in endless diversity of ways. One concretion may have become the center around which others grew, or a small concretion may have formed in the midst of a larger one, the quantity and state of the carbonate of lime varying from point to point. A certain

freedom or play of the particles, *i. e.*, a certain plasticity, seemed necessary to secure symmetrical forms, beyond which the magma simply hardened without form, as in the amorphous bands connecting concretions or overlapping them (Pl. XXVI, Figs. 8 and 6), or underlying them.

The peculiarity noticed in many of the concretions of their apparent growth upward by films or from a side, is analogous to the habit of crystallizing fluids which begin to form crystals along the line of attachment, and this in some cases seem dependent on the lamination of the clay beds.

It is singular, and I find Professor Hitchcock makes the same observation, that in the Fontainebleau limestone, with as much or less carbonate of lime in their composition, the calcite has carried the sand into its rhombohedral forms, which it has failed to do with the clay in the clay stones. It would seem that in the former case the carbonate of lime crystallized rapidly and *en masse*, as it were, in the sand, whereas in the latter the calcite formed more or less slowly, and was disseminated in minute points through a *plastic* mass of clay.

NOTE.—In Pl. XXVII, fig. 8*a* is the under view of fig. 8—a flat surface.

——:o:——

THE CONDYLARTHRA.

BY E. D. COPE.

(Continued from page 805, August number.)[1]

PHENACODONTIDÆ.

THE genera of this family display a uniformity in the structure of the true molar teeth not seen in the Periptychidæ. Their range of grade is seen in the premolars, especially those of the superior series. Thus in Protogonia, all of those teeth have but a single external lobe. In Phenacodus the fourth has two external lobes. In Diacodexis the second, third and fourth teeth have two external lobes. The premolars are unknown in Anacodon. While Protogonia is primitive in its superior premolars,

[1] It is necessary to notice two errata which occur in the part of this paper already published in the last number of the NATURALIST. In the diagnosis of the suborder Hyracoidea, page 792, line 10, fibula is printed instead of tibia. The same error occurs on page 793, line 13. Second, the figures of *Ectoconus ditrigonus* are natural size, and not two-thirds of it, as stated.

its inferior true molars come nearer to developing Vs than any other genus of the family. The definitions are as follows:

Last superior premolars with but one external cusp; inferior molars with Vs.
Protogonia.
Last superior premolars with two external cusps; inferior molars with well-developed cusps.....*Phenacodus.*
Inferior molars with flat grinding faces; no cusps.....*Anacodon.*
Second, third and fourth superior premolars with two external cusps; those of inferior molars well developed.....*Diacodexis.*

Of these genera the only one which is restricted to the Puerco epoch is Protogonia. Some species of Phenacodus are Puerco, but the majority are Wasatch, while the two remaining genera are Wasatch.

The two species of Protogonia are known in the Puerco fauna as the only ones, with three species of Phenacodus, which possess regularly quadrituberculate superior molars. The simplicity of their fourth premolar and the absence of the external cingular cusp of the superior true molars proclaim them the most primitive species, as they are the oldest, of the family. The smaller species, *P. plicifera* Cope[1] (Fig. 14), has a skull as large as that of a terrier dog. The *P. subquadrata* is larger and otherwise different.

In the genus Phenacodus Cope, we have the best known representative of the order Condylarthra, and the one to which the largest number of species is referred. Almost perfect specimens of the *P. primævus* (the type) and the *P. vortmani*, were found in the Wasatch Eocene sandstone of the Big Horn river of Wyoming (see Plates XXIX and XXX).

FIG. 14.—*Protogonia plicifera*; parts of superior and inferior dentition, nat size. From the Puerco beds of New Mexico. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

The dentition includes the normal number found in the least modified Mammalia, viz., I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$; and the series is not interrupted by important spaces. The canines are weak, and none of the premolars in either jaw resemble the true molars. The latter are quadritubercular, with intermediate tubercles both above and below. The last inferior molar has a fifth lobe.

[1] The best specimens of this species are not yet figured.

The skull (Fig. 15) is distinguished by the posterior prolongation of the nasal bones, which extend to between the orbits in *P. primævus* (Plate XXVIII), constituting a slightly nearer approach to the living genus Tapirus than exists in any other extinct genus now known; the premaxillaries are slender, and do not unite in front. Posteriorly they reach to the nasals, but not to the frontals. There are no postorbital processes either of the frontal or malar bones. Sagittal crest present. The palate is excavated beyond the posterior border of the last superior molar, and the pyramidal processes of the palatine bone are not separated from the maxillaries by a notch. Postglenoid processes prominent, no trace of preglenoid ridge. Posttympanic process short, widely separated from the postglenoid in front by the meatus auditorius, and from the paroccipital behind by the robust bases of both processes. Petrous bones probably small.

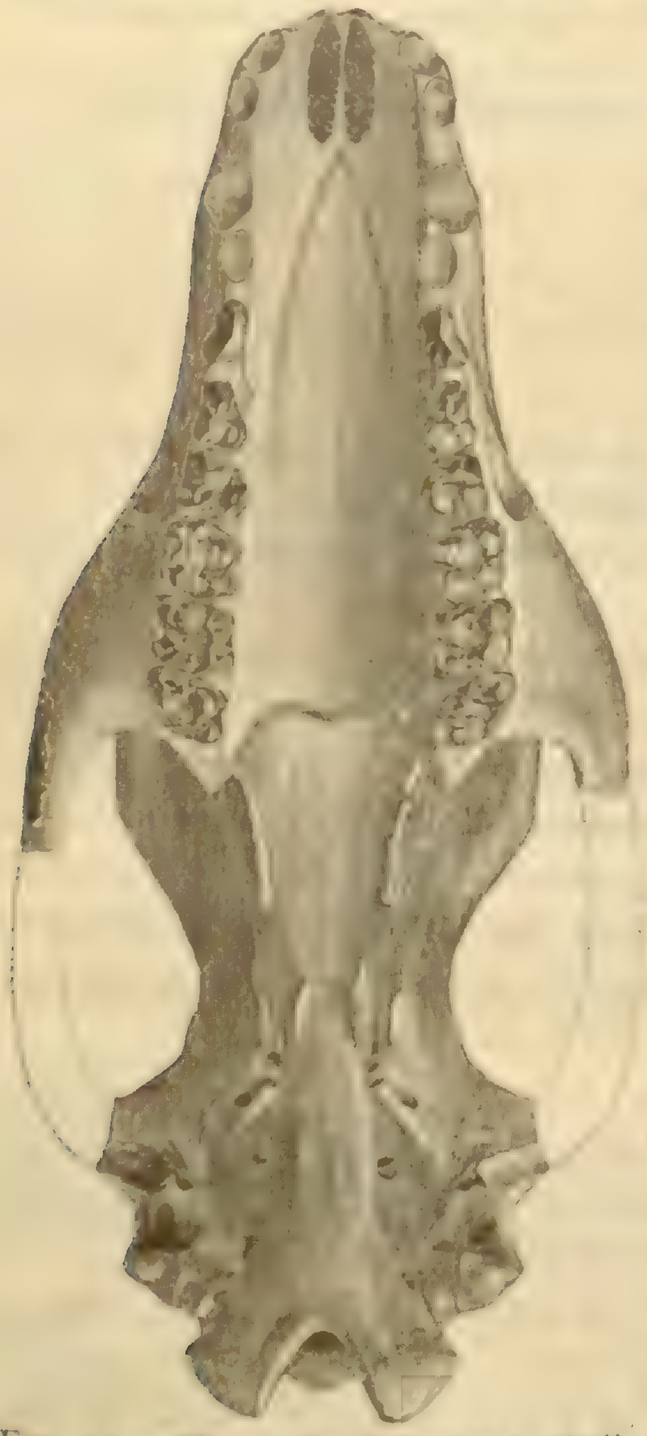


FIG. 15.— *Phenacodus primævus*; skull of specimen represented in Plate XXIX and figs. 17-20; one-half natural size, from below. From Wasatch beds of Wyoming. Original, from Report U. S. Geol. Survey of Terrs., III, F. V. Hayden in charge.

The axis has a cylindric odontoid, and its neural spine is well developed. A vertebrarterial canal. The articular faces of the succeeding cervicals are oblique and slightly opisthocœlous. The second dorsal has rather elongate diapophyses without metapophyses; the neural spine is narrow and rather elevated. The metapophyses are quite elevated on the posterior part of the series, and the centra become somewhat opistho-

Phenacodus primævus Cope, one-half nat. size.

cœlous and depressed. No anapophyses on either dorsals or lumbars. The latter have well-developed flat diapophyses, and the centra are keeled below. The postzygapophyses are not revolute, but they become oblique, so that the external parts of the surfaces are nearly vertical. The caudal vertebræ were probably numerous; the proximal have strong transverse processes, and the median are robust in the *P. primævus*. Some of them have chevron bones.

The tuberosities of the humerus (Fig. 16, *b b'*) are as well developed as in tapiroids. The condyle has no intertrochlear ridge, but the cylindrical part is smaller, as in Oreodon, Anoplotherium and Mesonyx. The epitrochlear foramen is a peculiar feature already mentioned. The head of the radius is transversely oval, without inferior interlocking angle. The distal extremity is truncate, and the scaphoid and lunar facets are not distinctly separated. The distal extremity of the ulna is a compressed tuberosity which is produced beyond the radius, to which it is oblique (Fig. 16, *d*).

The distal keels of the metapodial bones are distinct, but are quite short and entirely posterior.

The pelvis is of normal proportions. The

FIG. 16.—*Phenacodus primævus*: bones of specimen represented in Pl. XXIX; a little less than half natural size. Fig. *a*, scapula, glenoid cavity; *b*, humerus from front; *b'*, do. head; *c*, head of radius from below; *c'*, do., proximal view; *d*, ulna and radius, distal view; *e*, tibia, proximal end; *e'*, do., distal end. Original, from Wasatch epoch of Wyoming. From Report U. S. Geol. Surv. Terrs., Vol. III.

ilium is not much expanded, but its posterior superior bor thinned out. The anterior border is decurved in front peduncle is distinct and rather short, and has a triangular sec the narrower face being anterior and only apparent near acetabulum (Fig. 18).

The posterior foot was not entirely plantigrade, but was no more so than in Tapirus, adding a digit on each side to the t possessed by that genus. These digits are arranged in the of a circle, so as not to give unusual width the foot. The third is longer than the sec and fourth, and the fifth is longer than first. The astragalus has much the form that of a carnivorous mammal. The lat crests are well developed and of unequal e vation, the external being the most elong The median groove is wide and deep. neck is distinct, and is rather long, and is be slightly inwards. The head is transver oval, and its articular surface is uniform convex in all directions (Fig. 17). The p langes are not shortened, and the ungues a well developed, flat and obtuse.

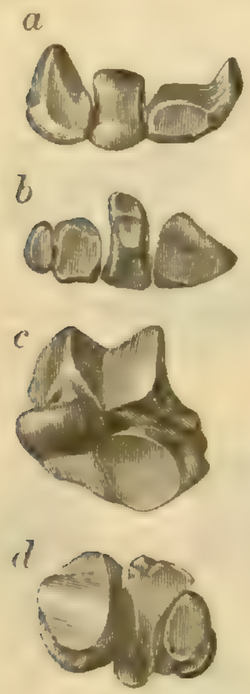


FIG. 17.—*Phenacodus primævus;* carpus and tarsus, one third nat. size, from animal represented in Plate XXIX. Fig. *a*, carpus, proximal view; *b*, proximal view of bones of second row of carpus; *c*, astragalus and calcaneum, distal view; *d*, cuboid and cuneiform bones, proximal view.

It is thus evident that the detailed char ters of the skeleton of this genus are as p itive as those derived from the study of t feet and teeth.

A cast of the cranial cavity gives the fo lowing as the general characters of the br The cerebral hemispheres are remarka small, each one being less by one quarter t the cerebellum. They are separated from the latter and from large olfactory lobes by strong constrictions. The posterior is occupied by a thick tentorium. In like manner a wide gr for a robust falx separates the hemispheres above. A notch resents the Sylvian fissure, and the lobus hippocampi is large. The vermis of the cerebellum is quite distinct, and lateral lobes are large. They are impressed laterally by the p rous bones, as in various ruminants. The anterior columns the medulla are not visible. There are traces of convolutions the hemispheres (Fig. 19).

The characters of the brain are very primitive, though the cerebral hemispheres are better developed than in the Amblypoda, which are themselves superior in cerebral structure to the genus Periptychus (Fig. 9).

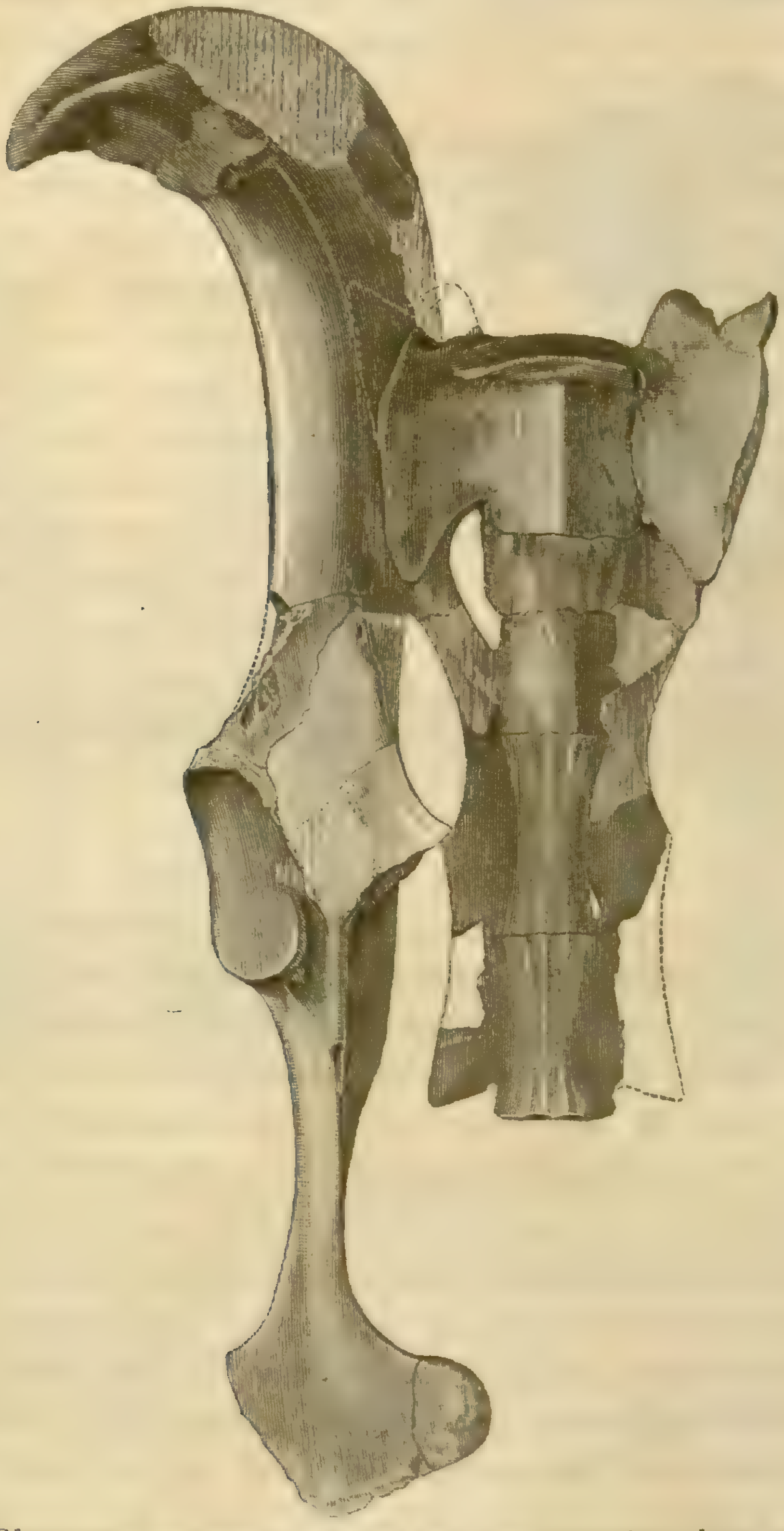


FIG. 18.—*Phenacodus primævus;* sacrum and right innominate bone minus much of pubis, individual represented in Plate XXIX; one half nat. size, from below. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

I refer nine species to this genus. Of these only two, *P. primævus* and *P. vortmani* are sufficiently well known to render the

generic reference certain. The others are mostly known from teeth, and it is highly probable that most of them belong to the genus. They are all from either the Puerco or Wasatsch formations—three from the former and six from the latter.

FIG. 19. — *Phenacodus primævus*; cast of brain case of specimen figured in Plate XXIX, one-half nat. size. Fig. *a*, left side; *b*, superior face; *c*, inferior face. Original, from Report U. S. Geol. Surv. Terrs., Vol. III, F. V. Hayden in charge.

The largest species of the genus, the *Phenacodus nunienus* Cope, was probably as large as the Malayan tapir. The measurements show that the *P. primævus* Cope, was proportioned much as in the common American tapir, but was of smaller size. The middle three toes of both feet reached the ground, while the first and fifth projected laterally and posteriorly, like the dew-claws of the hogs. The tail was longer and heavier than that of any of the living hoofed animals, resembling in its proportions that of the cats. The eyes were small, and the muzzle, though long, was singularly soft above. Whether this soft part was pierced by valvular nostrils, as in the hippopotamus, or was produced into a short proboscis, as in the saiga or in the tapir, cannot be certainly ascertained, but there are indications of the insertion of important cartilages, if not muscles, on the superior faces of the premaxillary bones (see Plate XXVIII).

The animal was probably omnivorous in its diet. It was not furnished with any weapons of offence or defence pertaining to the osseous system, so that it must have sought refuge in flight. The well developed muscular insertions of its limbs, and the digitigrade character of its step, indicate that it may have had considerable speed.

Its bones have been found wherever the beds of the Wasatch epoch occur, but most abundantly in Northern Wyoming. From the Wind River valley Mr. Wortman brought two specimens, and ten from the Big Horn basin. A figure of the skeleton was

published in the NATURALIST, 1883, p. 535, one-seventh natural size, and is here reproduced (Pl. XXIX).

Of the *Phenacodus vortmani* Cope, Mr. Wortman brought portions of four mandibles from the Wind River bad lands, and thirteen from those of the Big Horn (see Figs. 20, 21).

The limbs of this species are rather elongate for an Eocene mammal, and the anterior limbs are distinctly shorter than the posterior. The size of the animal is that of a bull-dog, but the head is smaller and the neck rather shorter, and not nearly so

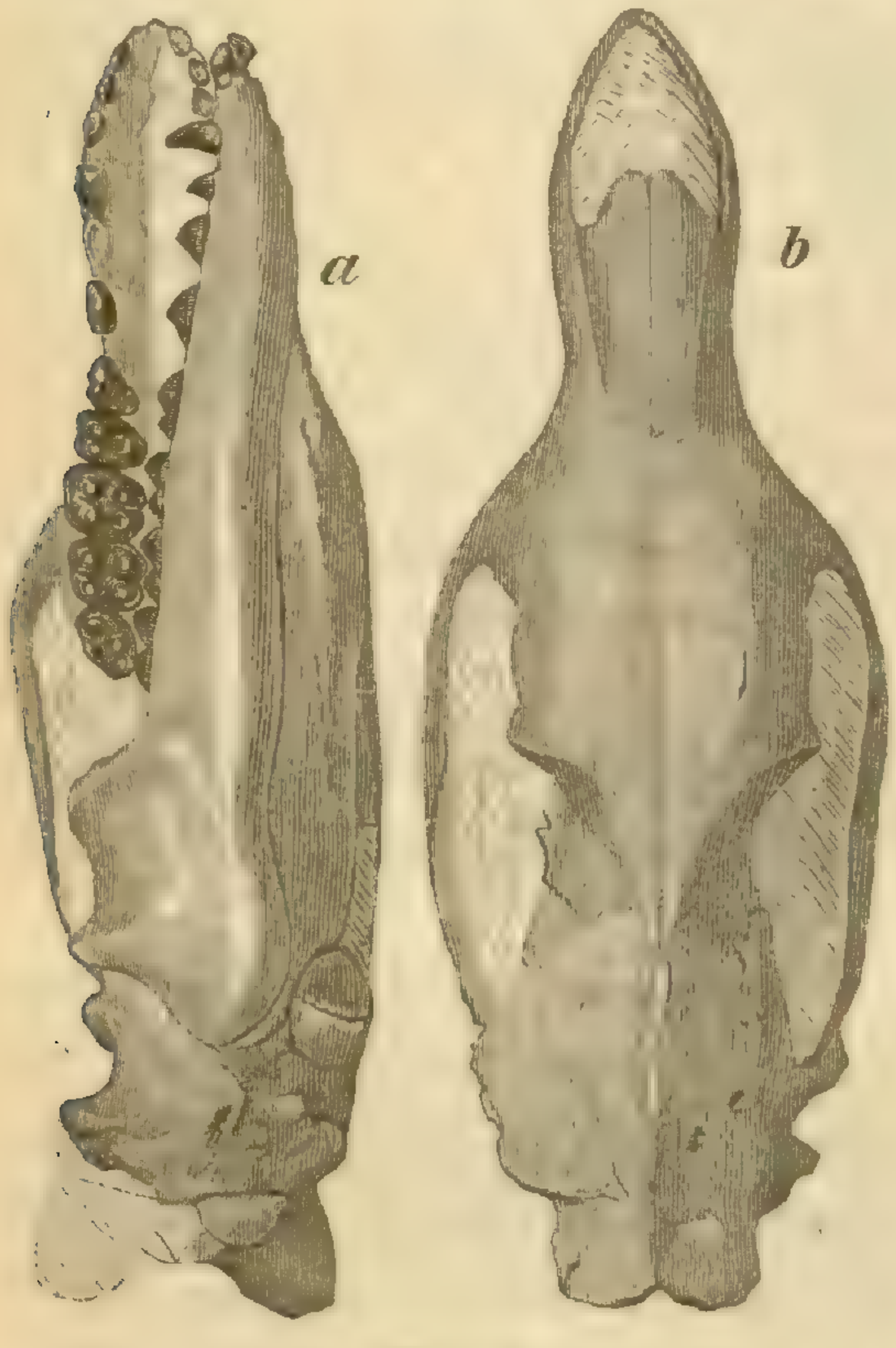


Fig. 20.

Fig. 21.

FIG. 20.—*Phenacodus vortmani*: skull of individual represented in Pl. XXX, one-half nat. size. Fig. *a*, from below; *b*, from above. The skull is somewhat distorted by pressure. From the Wasatch epoch of Wyoming. Original.

FIG. 21.—*Phenacodus vortmani*: individual figured in Plate XXX, one-half nat. size. Fig. *a*, humerus, proximal view; *b*, do., distal view; *c*, ulna and radius from front; *d*, tibia and astragalus from front; *e*, left metatarsus and part of tarsus, external view; *f*, metatarsus, proximal view, hallux displaced.

robust. The limbs have about the same proportions to the body as those of a bull-dog, but the anterior ones are shorter. The proportions of the parts of the limbs, and of the fore and hind limbs to each other, excepting the feet, are much as in the collared peccary. The feet of the latter animal are longer than in *Phenacodus vortmani* (Plate XXX).

We can thus imagine the *Phenacodus vortmani* as an animal of

the comparatively slender build of the bull-dog, with a neck and head proportioned more as in the raccoon, and with the rump more elevated than the withers, as in the peccary. The feet resembled those of a tapir or rhinoceros, but had a pair of short toes on each side which did not reach the ground. To this add a tail much like a cat's in proportions, and the picture is complete. The diet of this animal was omnivorous, with a smaller proportion of animal food than the hogs, for instance, use. The food is more likely to have resembled that of the quadrumana. What means of defence this species had, is not easily surmised, as the canine teeth and hoofs are not large.[1]

I have named this species after Mr. Jacob L. Wortman, of Junction City, Oreg., whose explorations in the West have been more than usually productive of important results.

The species of the Puerco epoch, of which the superior molars are known, differ from those of the Wasatch in the absence of the small external cingular tubercle which marks the space between the external tubercles. These are the *P. puercensis* and *P. suniensis* Cope, of which the former is very abundant, and about the size of *P. wortmani* (Fig. 22).

FIG. 22. — *Phenacodus puercensis*; parts of upper and lower jaws, three-quarters nat. size. Fig. *a*, superior molars from below; *b*, left mandibular ramus, external side; *c*, inferior molars from above. From the Puerco epoch of New Mexico. Original.

The molar teeth of the genus Anacodon resemble those of Phenacodus, but the cusps are replaced by flattened surfaces and the valleys represented by superficial wrinkles. They thus resemble somewhat the molars of certain bears. The only species, *A. ursidens* Cope (Fig. 23), is about the size of the *Phenacodus primævus*, and has been found in the Wasatch beds of Wyoming.

[1] I must here observe that in spite of the near resemblance of this species to the *P. primævus* in most respects, it presents two important differences. It has but three instead of four sacral vertebræ, and the ungues are wedge-shaped and not broadly rounded. I cannot avoid the belief that the species should be separated generically from Phenacodus, and therefore propose that the name of Trispondylus be used for the new genus in case its distinction be substantiated.

Diacodexis laticuneus Cope (Fig. 24, *b c*), is a small species, known so far from superior and inferior molars, found in the Big

FIG. 23.—*Anacodon ursidens* Cope, inferior molars from above, three-fourths nat. size. Original; from the Wasatch epoch of Wyoming.

Horn region of Wyoming (Fig. 24). The skull is probably as large as that of a gray fox. If properly placed in this family, it is the most specialized form, on account of the bicuspid premolar teeth.

FIG. 24.—Phenacodontidæ, nat. size. Fig. *a*, *Phenacodus brachypternus* Cope, inferior molar from above; *b*, do. with ramus, external side. Figs. *b c*, *Diacodexis laticuneus* Cope; *b*, maxillary teeth from below; *b'*, do. from outer side; *c*, last inferior molar from above. All from the Wasatch epoch of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., Vol. III.

MENISCOTHERIIDÆ.

This family includes the single genus Meniscotherium.

Superior molars with external Vs, and with intermediate tubercles; the latter with the anterior crescentic, the posterior oblique, forming a crest with the posterior inner; anterior inner conic. Inferior molars and last premolar with two Vs; other inferior premolars without internal lobes; fourth superior premolar with two external lobes . . . *Meniscotherium.*

As already indicated, with this genus we enter a new family of the Condylarthra, and one which superadds to its general structure a considerable specialization of the molar teeth. The present genus is the only one of the family yet known, and it is represented by but three species. With present knowledge it must be asserted that the range of this genus was limited both in time and space. The remains of the species have been derived from the Wasatch beds of New Mexico, and from a horizon from near its base which overlies the Puerco. The genus has not been found in any other of the areas of the Wasatch deposits, but it occurs abundantly in its locality, so that it is possible to determine its general structure (Figs. 25–28).

Dental formula, I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$; without diastema. Incisors and canines in both jaws small. The superior molars of this genus have some resemblance to those of Hyopotamus, but the inferior molars are different, and of the Anchitherium type. The temporary last superior molar differs from its successor, the permanent fourth premolar, in its more complex character. It is in fact identical in structure with the true molars. The second and third milk molars differ from their successors in their greater anteroposterior extent. The third has an internal lobe opposite the posterior half of the external wall (Fig. 25, *b c*).

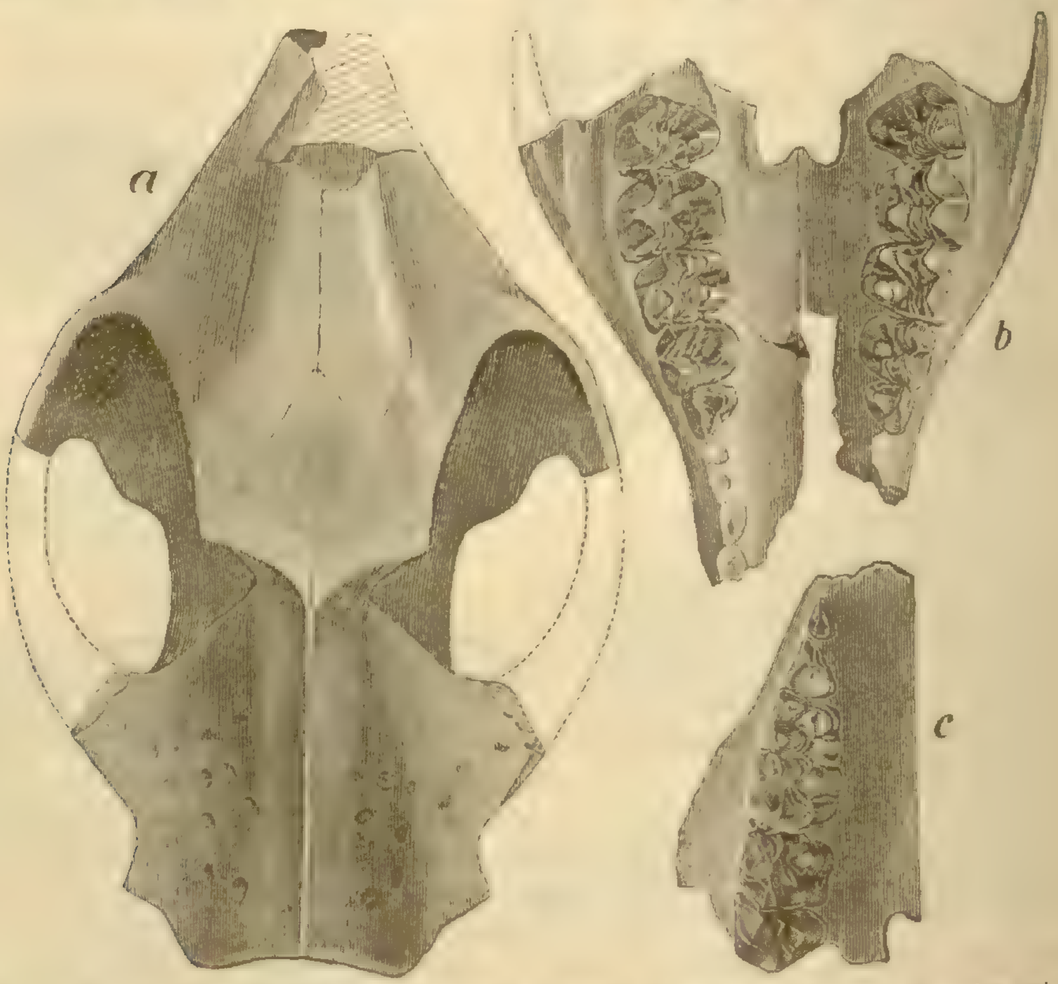


FIG. 25.—*Meniscotherium terrærubræ;* parts of crania, three-fourths nat. size. From the Wasatch epoch of New Mexico. Fig. *a*, cranium No. 1 from above; *b*, do. No. 2 from below; *c*, do, No. 3, displaying deciduous Pm. III and IV from below. Original, from Report U. S. Geol. Survey Terrs., III, F. V. Hayden in charge.

Orbits widely open posteriorly. Palate excavated between the molars posteriorly. A postglenoid process. Auricular meatus widely open below. Post-tympanic and paroccipital processes united. Occipital and sagittal crests. Foramen ovale scarcely separated from f. lacerum anterius. Mandibular symphysis coössified. Mandibular condyle uplooking. Brain not so small as in Phenacodus.

The cervical vertebræ are, like those of Phenacodus, of medium length and slightly opisthocœlous. They, with the lumbars, have

an inferior keel. The disparity in size between the anterior dorsals and lumbars is marked. The odontoid process is cylindric. Metapophyses of lumbars well marked. No anapophyses. Neural canal rather large.

The head of the scapula has a curved coracoid process. The spine rises abruptly from the neck. The humerus is much like that of Phenacodus or a carnivore. The tuberosities are not produced, and there is no external epicondyle. The internal epicondyle is large, and sends upwards the bridge that incloses the epicondylar foramen.

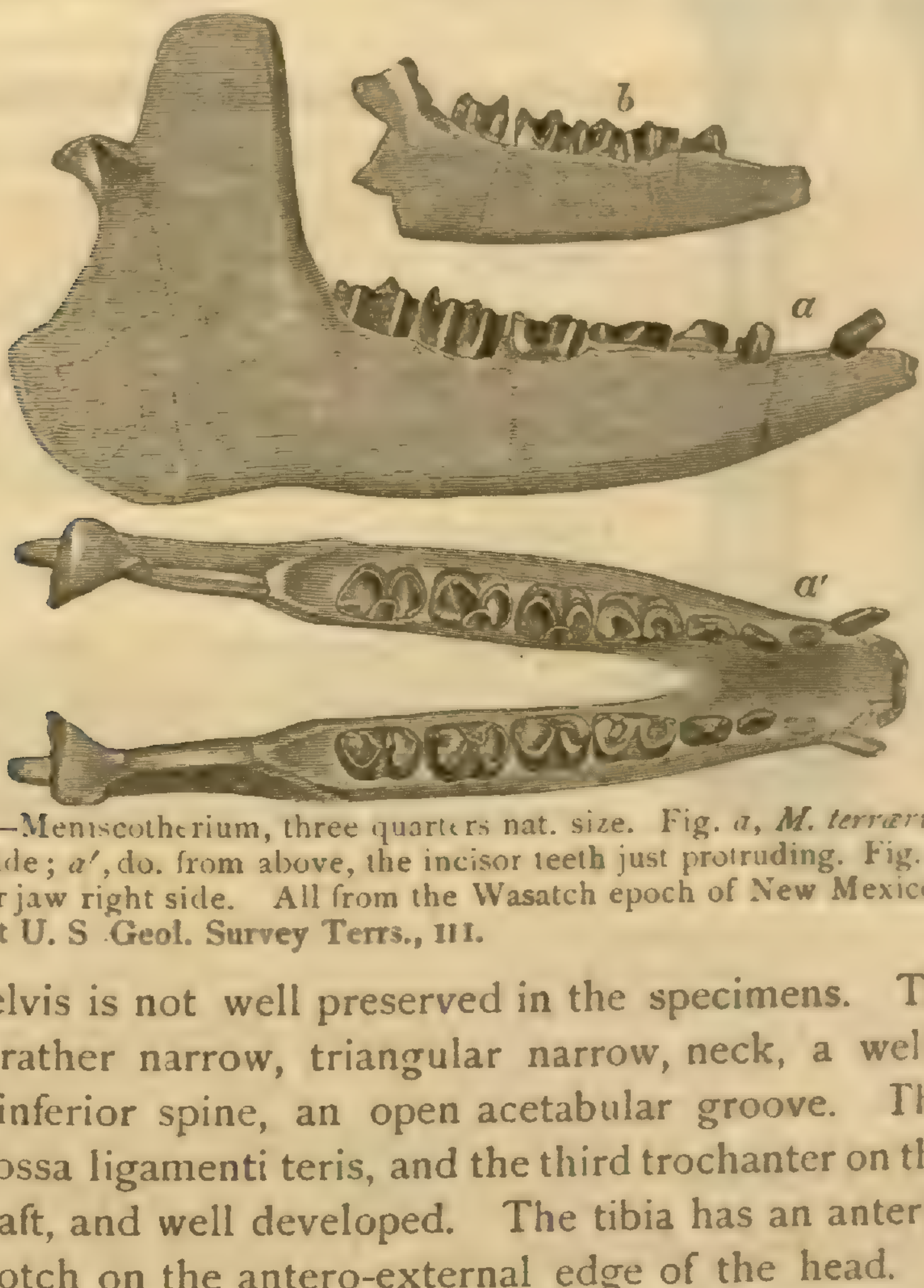


FIG. 26.—Meniscotherium, three quarters nat. size. Fig. *a*, *M. terrærubræ*, lower jaw, right side; *a'*, do. from above, the incisor teeth just protruding. Fig. *b*, *M. tapiacitis*, lower jaw right side. All from the Wasatch epoch of New Mexico. Original, from Report U. S Geol. Survey Terrs., III.

The pelvis is not well preserved in the specimens. The ilium shows a rather narrow, triangular narrow, neck, a well-marked anterior inferior spine, an open acetabular groove. The femur shows a fossa ligamenti teris, and the third trochanter on the middle of the shaft, and well developed. The tibia has an anterior crest, and no notch on the antero-external edge of the head. The internal malleolus is a prominent tuberosity, and the astragalar face is scarcely grooved, and is oblique, as in the Creodonta. The distal extremity of the fibula articulates with the sides of the astragalus, but not with the calcaneum. The calcaneum much resembles that of Phenacodus. It is elongate and the astragalar facet is not longitudinal, but is very oblique. The astragalus has trochlear keels of unequal height, and a shallow groove between

them, much less marked than in Phenacodus, but not so flat as in Periptychus. The neck is elongate, and the distal articular surface is convex in every direction (Figs. 27, *d*, 28, *c*).

The number of toes in Meniscotherium is unknown. Metapodial bones preserved are rather narrow, leading to the supposition that the digits are similar to those of Phenacodus and Periptychus. The posterior keels of the distal extremities of the metapodials are distinct.

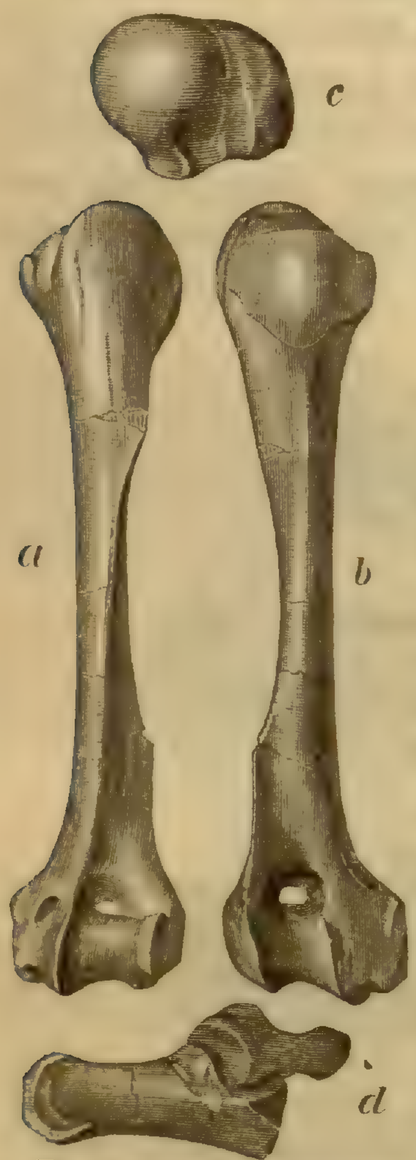


FIG. 27. — *Meniscotherium terrærubræ;* limb bones, nat. size. Fig. *a*, left humerus, front; *b*, from behind; *c*, proximal end; *d*, astragalus and calcaneum of another animal, external side. From Wasatch beds of New Mexico.

This genus is an interesting exemplification of a general truth. That is, that at any given geological epoch a few general types predominate, and that to these few must be referred forms whose varied characters would, on superficial examination, lead to a belief in an equally varied representation of higher divisions. Thus Meniscotherium exhibits a dentition decidedly Perissodactyle, and to that order I accordingly referred it when I originally discovered it. But the evidence of abundant material shows it to be undoubtedly Condylarthrous, and that it enters the same order as Phenacodus. Thus the only possible Perissodactyle has been removed from the Puerco fauna.

Three species of the genus are known, all from the Lower Wasatch beds of New Mexico. The type, *M. chamense* Cope is undoubtedly Wasatch. The *M. terrærubræ* is about the same size. It is about the size of a fox, but with a very different physiognomy. The profile is curved, the muzzle short, and the eyes large. The body is not so slender as in Phenacodus or a fox, having the more robust proportions of a raccoon. The fore and hind legs were rather short, and of equal length, so that the rump was flattened as in the dog. There was a large tail. The species is one-third (linear) larger than the *Hyrax capensis*. It was probably a vegetarian (Figs. 25–26).

a

them, much less marked than in Phenacodus, but not so flat as in Periptychus. The neck is elongate, and the distal articular surface is convex in every direction (Figs. 27, *d*, 28, *e*).

The number of toes in Meniscotherium is unknown. Metapodial bones preserved are rather narrow, leading to the supposition that the digits are similar to those of Phenacodus and Periptychus. The posterior keels of the distal extremities of the metapodials are distinct.

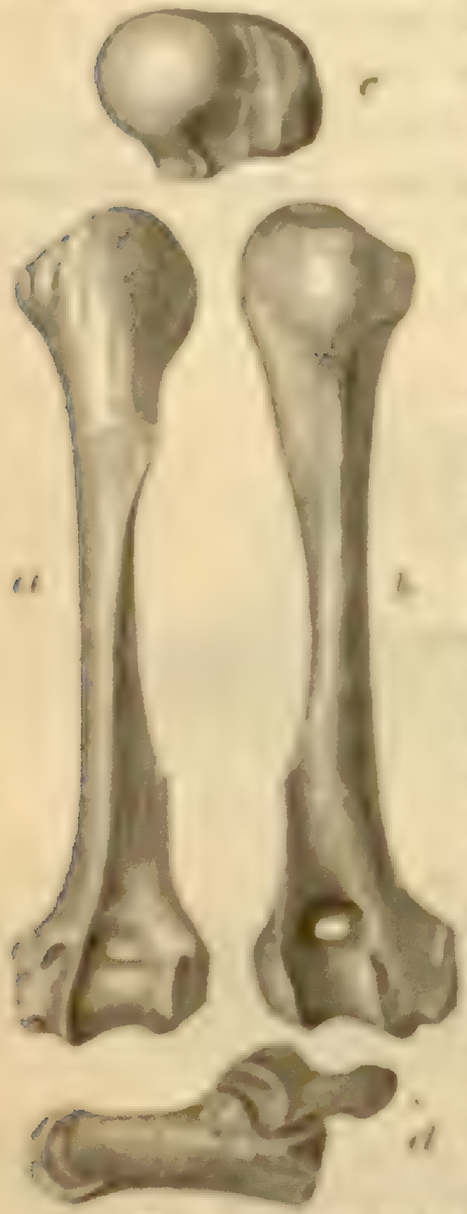


FIG. 23.—*Meniscotherium terrarubræ*; fore bones, nat. size. Fig. *a*, left humerus, front; *b*, from behind; *c*, proximal end; *d*, astragalus and calcaneum of another animal, external rills. From Wasatch beds of New Mexico.

This genus is an interesting exemplification of a general truth. That is, that at any given geological epoch a few general types predominate, and that to these few must be referred forms whose varied characters would, on superficial examination, lead to a belief in an equally varied representation of higher divisions. Thus Meniscotherium exhibits a dentition decidedly Perissodactyle, and to that order I accordingly referred it when I originally discovered it. But the evidence of abundant material shows it to be undoubtedly Condylarthrous, and that it enters the same order as Phenacodus. Thus the only possible Perissodactyle has been removed from the Puerco fauna.

Three species of the genus are known, all from the Lower Wasatch beds of New Mexico. The type, *M. chamensis* Cope is undoubtedly Wasatch. The *M. terrarubræ* is about the same size. It is about the size of a fox, but with a very different physiognomy. The profile is curved, the muzzle short, and the eyes large. The body is not so slender as in Phenacodus or a fox, having the more robust proportions of a raccoon. The fore and hind legs were rather short, and of equal length, so that the rump was flattened as in the dog. There was a large tail. The species is one-third [linear] larger than the *Hyrax capensis*. It was probably a vegetarian (Figs. 25–26).

The *M. tapiacitis* Cope, is the least species, and presents some dental peculiarities (Fig. 26, *b*).

With this genus and family we close the Condylarthra. That the order gave origin to the Amblypoda is highly probable. Besides this order, the Proboscidea and Hyracoidea must be traced back to it. It stands as the remote ancestors of the Perissodactyla and Artiodactyla, through the Amblypoda. They are the primitive hoofed mammals or Ungulata, and probably existed, like the Plagiaulacidæ, in Cretaceous time.

FIG. 28.—*Meniscotherium terrærubræ*; bones of individuals represented in fig. 27, three-quarters nat. size. Fig. *a*, femur behind; *a'*, front; *b*, tibia from front; *b'*, distal extremity. Fig. *c*, astragalus of fig. 27, distal view; *c'*, superior view. From Wasatch epoch of New Mexico. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

The discovery of the Condylartha is a good illustration of what may be derived from persevering scientific research. Prior to this event the history and affinities of the great division of the hoofed Mammalia were, for its earlier stages, a total blank. Few but specialized forms were known, and the affiliations of these with the two aberrant groups of Proboscidea and Hyracoidea, and with each other, could not be guessed. Now the phylogeny is, in the main, certain, and the point of connection with the clawed (unguiculate) orders, not difficult to discern.

The following table exhibits the distribution in time of the species of the suborder Condylarthra:

PERIPTYCHIDÆ.

	Puerco ep.	*Wasatch ep.*	
Hexodon	1		
Ectoconus	1		
Periptychus	3		
Hemithlæus	2		
Anisonchus	5		
Haploconus	4		
Zetodon	1		17
PHENACODONTIDÆ.			
Anacodon		1	
Protogonia	2		
Phenacodus	2	7	
Diacodexis		1	13
MENISCOTHERIIDÆ.			
Meniscotherium		3	3
			33

EXPLANATION OF PLATES.

PLATE XXVIII.

Skull of *Phenacodus primævus*, from specimen figured in Plate XXIX, one-half nat. size. Fig. *a*, right side of skull; *b*, top of skull; *c*, right mandibular ramus from above.

PLATE XXIX.

Skeleton of *Phenacodus primævus*, one-seventh nat. size; found by Mr. J. L. Wortman, and mounted by Mr. J. Geismar. From the Wasatch beds of the Big Horn river, Wyoming. (This plate was published in the NATURALIST, 1883, p. 535, and there erroneously stated to be one-fourth natural size.) Mus. Cope.

PLATE XXX.

Skeleton of *Phenacodus vortmani*, two-ninths nat. size, found by Mr. J. L. Wortman in the Wasatch beds of the Big Horn river, Wyoming, and mounted by Mr. J. Geismar. Mus. Cope. Fig. *a*, *manubrium sterni*.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The use of trinomial nomenclature in biology has been revived in the United States during the last ten years, and its adoption has been easy because it supplies a want. Subspecies are often very recognizable, as are in fact species which inosculate with other species at the present time, so as to be inseparable by definition. For the recognition of such forms the trinomial nomenclature is indispensable.

All the innovations in nomenclature from this side the water

have not been, in our opinion, so happy. We note four such which have not been generally adopted, though they have advocates in some quarters: (*First*) The type of a genus shall be the species which stands first on the list made by the original describer. This method has been generally discarded, and the law of exclusion been adopted in its stead. That is, the species remaining after others have been subtracted as representing new genera, bears the earliest generic name. (*Second*) When an existing specific name has been used for a genus, the same name shall continue to be used for the species instead of a new one. There result from this method such names as *Sialia sialis*, *Mephitis mephitica*, *Calamus calamus*, *Scomber scomber*, etc. It would seem superfluous to object to such names were it not that they have advocates. Dr. Lydekker's assertion that they are "ridiculous" seems to us to cover the ground. We know of no argument in their favor. (*Third*) Any generic name which is attached to the description of a species shall be regarded as the generic name of that and other congeneric species, whether such genus has been defined or not. This proposition has been negatived by the almost entire vote of American naturalists who responded to the circulars of the Dall committee on nomenclature of the American Association for the Advancement of Science for 1877. Nevertheless some American naturalists adopt such *nomina nuda*. (*Fourth*) That a name once used cannot be used again, though it be an evident synonym. To discard a name because it may be found in some list of synonyms seems to us to be increasing rather than diminishing confusion. To put the present system of nomenclature through a process of renovation such as this proposition requires, would be impracticable. Hence we disapprove of such names as Zapus, Amphisaurus, etc.

We add a consideration respecting the adoption of the names of higher groups, as families, orders, etc. We propose the following rules as agreeing most nearly with present practice, and as fulfilling most nearly the object of all rules, the securing of justice to persons concerned. We propose that names of all divisions higher than genera:

I. Be only adopted when accompanied by a definition.

II. That they be preserved for the division for which their original proposers intended them as nearly as possible.

NOTE.—What their proposers intended them for can as often

be learned from the contents of such divisions as from the definition, since in early stages of the science definitions are always defective. This rule will be definitive of the action of the law of priority which is now often neglected in the case of the higher divisions.

—— Good illustrations are an important part of scientific literature, and in some of the departments essential. This is especially true of embryological and histological work. The difficulty encountered in the United States is the comparative expensiveness of the ordinary processes. For several years American naturalists and institutions have been seeking for cheaper methods. The Smithsonian Institution and the National Museum have been especially active in this work, doubtless with the excellent object of securing the greatest good to the greatest number. There are many phototypic processes, and many of them have been tried. We are sorry to have to confess that the results have not been as successful as has been hoped. These processes do well enough for fugitive literature, but for permanent scientific work they are rarely good. In the case of line drawings the metal appears to be too soft, and breaks more or less during the process of manufacture. The strong shades of direct photography will forever, we fear, prevent their displaying surfaces clearly, except in the medium lights. The alternative seems to be to endeavor to secure the best illustrations at cheaper rates than are now paid. If we do not do so, there are strong symptoms that the best American work will seek European channels of publication.

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RECENT LITERATURE.

BIOGEN, BY DR. COUES.[1]—The present 12mo volume consists of a lecture delivered before the Philosophical Society of Washington, with introduction, preface and a liberal appendix. In the Preface we find a narrative account of the reading of the paper, and the criticisms, with elicited comments thereon. The Introduction is an extract from the official record of the meeting of the society on the same occasion. The first is written in Dr. Coues's graphic and entertaining style. The lecture itself is agreeable reading. As to the philosophy of the lecture, it may be summarized thus: As a biologist and familiar with animals, Dr. Coues perceives more in life than unintelligent forces, and he insists on its essential diversity from them. To sustain this position he cites many of the arguments usually adduced on this side of the question, some of which are very pertinent, but none of which are conclusive. However, towards the end of his remarks he takes the real and impregnable position of the vitalists, in the

[1] Biogen. Speculation on the origin and nature of Life. By Professor Elliott Coues. Boston: Estes & Lauriat, 1884.

phenomena of consciousness and mind. Had Dr. Coues been contented to let his case rest here, he could not have been answered. But he goes further, and discusses that difficult problem, the relation subsisting between mind and matter. He here commits the usual error, the confusing of *attribute* with *substance*. He talks about "mind-stuff" and "soul-stuff" and denies it the qualities of matter. His immaterial matter he calls Biogen. "Biogen" he says (p. 55), "itself of course is alive, it *is* life; and biogen may be defined as spirit in combination with the minimum of matter necessary to its manifestation." The best way to exhibit the fallacies involved in this sentence, is by a paraphrase viz: Heat of course is in motion, it is motion; and heat may be defined as motion in combination with the minimum of matter necessary to its manifestation. The appendix is chiefly devoted to an exposition of this doctrine.

Professor Coues's arguments for the distinctive importance of "mind in nature" are excellent; and his reasons for believing that the chemical constitution of protoplasm is not all there is of life, are weighty. It is when he tries to wed mind and matter that he falls into the difficulties that have floored many others before him, on both the materialistic and idealistic sides of the question.

BARROIS' PALÆOZOIC FORMATIONS OF ASTURIAS AND OF GALICIA.[1]—Asturias and Galicia, we are told by our author, form for the naturalist one region, bounded to the south by the Cantabrian chain, some of the summits of which rise above 2500 meters. From these mountains to the ocean extend series upon series of ridges, separated by profound transverse valleys, and well forested. The steep slopes render the heights difficult of access in the south, and in the center the vegetation masks the strongly inclined coal beds. These Asturian mountains are rich in iron, zinc, mercury, manganese, cobalt, and coal, and on account of these riches more than sixty geologists, commencing with P. Gaspar de Ibarra in 1644, have written upon the province of Oviedo.

After an enumeration of these memoirs M. Barrois attacks the lithology of the sedimentary rocks, of which Asturias is almost entirely composed, the eastern part consisting of limestone, the western of schists and quartzites which lie directly upon the archæan crystalline schists of Galicia. The plutonic rocks consist of granites, quartziferous porphyry, diorites, diabase, and recent quartziferous kersantites.

The fossiliferous horizons of the region are almost exclusively calcareous, and it is thus easy to draw a parallel between the Devonian and Carboniferous faunæ. No foraminifera have been noted in the Devonian limestones; madrepores, and especially

[1] Recherches sur les Terrains Anciens des Asturies et de la Galicie, par Chas. Barrois, Lille, 1882. Ouvrage accompagné d'un Atlas de 20 planches.

reef-corals, are common in both Devonian and Carboniferous, but other orders of Anthozoa are rare or absent. Crinoids are absent in the Silurian of Asturias, but the Devonian furnishes genera identical with those of the Rhine, and the Carboniferous is rich in species. Echini occur in the Carboniferous, but have not been found in the underlying formations. Bryozoa occur in both Devonian and Carboniferous, and 112 species of Brachiopoda are enumerated by our author in the three formations, by far the greater part of them from the Devonian. The Lamellibranchiata Asiphonida are better developed than the other divisions of bivalves, and the Gasteropoda Siphonostomata are entirely absent

Cephalopoda, so greatly developed in adjoining countries, play an insignificant role in Asturias; and the crustacea are limited to trilobites, one ostracodous carboniferous species excepted.

The sixth chapter treats of the earth-movements, denudation, etc., which have modified the palæozoic strata since their first appearance.

This volume, remarkable in itself as a monument of research, becomes still more so when the multiplicity of the labors and comparative youth of the author are considered.

FRIEDLÄNDER'S BIBLIOTHECA HISTORICO-NATURALIS ET MATHEMATICA.—This is a bulky strongly-bound octavo volume apparently of upwards of a thousand pages, which afford good evidence of the great demand made by scientists for the separate reprints of special papers, and of the success to which the Friedländers have attained in meeting this demand. To what an extent natural science has become specialized may be learned by glancing through this series of catalogues. Another fact of interest is the great disproportion between the number of general works and that of special papers, notes, brochures and memoirs. The practice of having a few reprints struck off for private distribution among one's scientific friends and correspondents has proved one of the highest value to those engaged in special lines of research. Such "separata," "reprints," "extras," as they are variously termed, find their way, after the death of their owners and the dispersal of their libraries, by means of the second-hand book-dealers, into the hands of specialists of a later generation, and thus crop after crop of papers are handed down in series of intellectual ancestry. The Cuvier or Von Baer of the old world, when he dies, bequeaths, in this indirect way but by a sure title, his intellectual works to his European or even transatlantic heirs engaged in the same line of study as his prototypes of the first years of the century.

The book is illustrated by a portrait of the founder of the firm, Julius Friedländer, who traveled in the United States, whose doctor's dissertation was a mathematical thesis, and among whose Berlin friends was Alexander Humboldt. He died in 1862.

The catalogues are separately paged, and the system of classification is a natural and convenient one, beginning with the history of zoölogy, "Miscellanea zoölogica," zoö-geography, faunæ, comparative anatomy, including embryology and morphology, as well as "Darwinismus." A separate catalogue is devoted to man, and nearly each large class of the animal kingdom has a separate catalogue. So with the vegetable kingdom; then follow the lists of works relating to palæontology, geology, mineralogy, etc. The catalogues are not of course designed to be complete bibliographies, but represent the enormous stock carried by the firm. At the same time not only is such a catalogue useful to libraries and bookbuyers, but it is valuable for reference by specialists.

BESSEL'S SMITH SOUND AND ITS EXPLORATION.—This is both a timely and authoritative essay, which the learned and experienced author has compiled from a long list of authors whose works are enumerated at the end of the brochure. As the compiler and editor of the voyage of the *Polaris* had only a few meager journals and a log-book at his disposal, Dr. Bessels has dwelt at length on that voyage, frequently using entire passages from his own narrative, the map being a photo-lithographic reproduction of that contained in his "Amerikanisch Nordpol Expedition."

At the close of the essay Dr. Bessels remarks that "the position of Greely and his party is not a dangerous one, although it is critical. He probably has provisions sufficient to last until the autumn of 1884, without taking the fourteen musk-oxen into consideration; these, according to his own statement, would provide him and his men with meat for seven months, even though issued as often as three times a week. Captain John Ross, not as well equipped as he is, spent four consecutive years in the Arctic regions, and still made good his retreat; but at the same time we must not forget that he wintered in lower latitudes, where the sun is not so long below the horizon as in Lady Franklin bay."

Finally he claims that we should not be disheartened by the failures in Arctic explorations of the last few years. "Arctic exploration, like warfare, has in the course of time fairly become a science, and the danger of now wintering in high latitudes is much less than it was twenty years ago." He adds that "our knowledge of the distribution of land and water in the vicinity of the Poles is almost as imperfect as it was at the time when Cook made his memorable voyage towards the South Pole, and when Forster, his scientific companion, tried to convince him that the vast ice-floes obstructing their passage were not of meteoric origin." The essay is reprinted from No. 30 of the Proceedings of the U. S. Naval Institute.

LECHE'S ANATOMY OF THE PELVIC REGION IN THE INSECTIVORA.[1]—In this work the osseous, nervous, and muscular anatomy of the pelvic region of many species of insectivores is fully considered in about a hundred pages of text, and illustrated with ten well-executed plates. The examples described include Galeopithecus, two species of Tupaia, a Macroscelides, *Parasorex socialis*, *Erinaceus europaeus*, *Centetes ecaudatus*, *Hemicentetes variegatus*, *Ericulus nigrescens*, both forms of Myogale, Urotrichus, three species of Talpa, *Condylura cristata*, *Scapanus breweri*, two forms of Sorex, *Crossopus fodiens*, *Blarina brevicauda*, three kinds of Crocidura, and *Chrysochloris inaurata*. Thus every family of Insectivora is represented, excepting the Myrhomyidæ and Solenodontidæ. The os acetubuli or fourth bone of the os inonminatum is figured in various carnivores and rodents as well as in insectivores, and is stated to be present in marsupials and edentates. This bone was first noted by Cuvier, and called by him "os cotyloidien," but has since been very generally ignored by naturalists.

GAUDRY'S "LES ENCHAINEMENTS DU MONDE ANIMAL."[2]—Though this able and eloquent French palæontologist states that the aim of all researches among extinct forms is to find the plan of creation, he yet admits the evolution of the animals of one epoch from those of the preceding, and believes that the full scheme of life-development will one day be discovered. The various classes of articulates, fishes and reptiles, are reviewed with the purpose of bringing into prominence the relations which connect the extinct fauna with each other and with recent forms.

But while our author admits that the passage from species to species, genus to genus, and family to family is fully proved, he states that palæozoic fossils have not yet furnished positive proof of the passage of animals from one class to another, since the principal classes of marine invertebrates were present in the Cambrian, and the Permian reptiles are as unlike fishes as possible.

REPORT OF THE U. S. COMMISSIONER OF FISH AND FISHERIES FOR 1881.—This bulky volume is not inferior in size to any of its predecessors in the series, and in fact is rather thicker, numbering 1146 pages. Nearly half the volume is occupied with materials for a history of the mackerel fishery by Messrs. Goode, Collins, Earll and Clark. The purely scientific portion is devoted to a list by Professor H. E. Webster and James E. Benedict, of the chætopod worms discovered at Cape Cod, nearly twenty new species being described and figured. Mr. John A. Ryder reports on the protozoa and protophytes as the primary or indirect source

[1] Zur Anatomie der Beckenregion bei Insectivora mit besonderer Berücksichtigung ihrer morphologischen Beziehungen zu derjenigen anderer Saügethiere. Von Wilhelm Leche. Mit 10 tafeln. Stockholm, 1883.

[2] Les Enchainements du Monde Animal dans les temps geologiques. Fossiles primaires. Par Albert Gaudry, Paris, 1883.

of the food of fishes; also on the retardation of the development of the eggs of the shad, a very interesting essay; and Mr. H. J. Rice also writes upon the same subject, while Mr. S. A. Forbes reports on the first food of the common whitefish, which consists of the smallest species of Entomostraca.

THE WOODS AND TIMBERS OF NORTH CAROLINA.—This is a compilation by P. M. Hale, from the botanical and geological reports of Drs. Curtis, Emmons and Kerr, to which are added information obtained from the Census Bureau, with reports from the several counties. A recent visit shows great improvement in the business activity and condition of the State. The Agricultural Department, by its museum and timely, authoritative publications like the present and others elsewhere mentioned, is doing a great deal in making the forests and mineral resources of the State better known, both at home and abroad. North Carolina is famous for its vast forests, and this hand-book is an interesting and valuable résumé of the characteristics and distribution of the forest trees of the State. The book owes its value largely to the original report of the Rev. Dr. Curtis printed in Emmon's Report on the Geology of the State, and reproduced in full.

A BOTANIST'S VACATION.[1]—A delightful little book from the pen of the genial Professor of Botany in the University of Pennsylvania reaches us just as the annual longing for rest and recreation comes to every brain-worker. It is a sermon in the gospel of relaxation, and it is so well preached that every reader will want to get a boat and follow the sailor-botanist down and up and across the Chesapeake and Delaware bays. There is a good deal of botanical inspiration in the book, and it is well worth reading by any one proposing to take a few week's run on the water. —*C. E. B.*

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[1] *Vacation Cruising in Chesapeake and Delaware Bays.* By J. T. Rothrock, M.D., Professor of Botany in the University of Pennsylvania. Illustrated. Philadelphia, J. B. Lippincott & Co., 1884. 12mo, pp. 262.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—*The Greely Expedition.*—It is impossible to give in the NATURALIST a full account of this unfortunate yet successful expedition, but the following abstract will cover the principal features of its history, as known up to the present time. The four miles advance towards the Pole has been secured at a loss of nineteen lives, including that of the leader of the advance party. Fortunately for the cause of science, the whole of the records and instruments of the expedition have been saved. The health of the entire party during their two years' stay at Lady Franklin bay seems to have been excellent, and this, taken along with the experience of the crew of the *Eira*, goes to prove that scurvy and other diseases usually thought to be incident to an arctic climate can all be avoided with suitable clothing, proper and abundant food, and a good, well-warmed house, if proper discipline is maintained. It is said that the scientific work done by this expedition far surpasses in importance, completeness and scope that accomplished by any other. This is not the place to enter into a criticism of the actions of the leaders of the two relief expeditions which so signally failed to accomplish their purpose. Through their failure nineteen valuable lives have been lost, and had not Commander Schley acted with the utmost alertness and promptitude, forcing his way onward even at the risk of grounding on the ice, not a man would have been saved. Forty-eight hours more would have completed the destruction of the entire party.

Results show that it would have been better had the party remained at their station, where they appear to have had plenty of provisions and abundance of game, but their expectation was to find a sufficient supply of provisions cached for them by the expeditions which had failed to reach them, and they could not know

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

that relief was on its way. The surprise and disappointment experienced when they found themselves without efficient protection and with totally insufficient provisions, compelled to endure the rigors of a third winter, must have exceeded anything that can be conceived by those who did not share the experience. Reduced to feed on seaweed, rock-lichens, sealskin and shrimps, of which latter the supply was very limited, it is no wonder that they gradually weakened and died. Sergeant Cross died in January, in April he was followed by Christiansen (half-breed), Edwards (Eskimo), Lieutenant Lockwood and Seargeants Linn Rice and Jewell; four others died in May, and seven in June, including Dr. Octave Pavy, the surgeon of the expedition, and Lieutenant Kislinburg. Dr. Pavy was an experienced Arctic traveler. He took part in an expedition sent out by France, then spent several years among the Eskimos in Lady Franklin bay and Grinnell Land; next formed one of the members of the Howegate expedition, and lastly joined the party commanded by Lieut. Greely. He was born at Havre, France.

AFRICA.—*Madagascar.*—This island, according to M. Alf. Grandidier, was discovered by the Portuguese on the 10th of August, 1500, instead of, as usually stated, the 1st of February, 1506. It was well known to the Greeks and Arabs, and, spite of the doubts of commentators, arising from ignorance of the regularity of the winds and currents and the usages of local navigation, it is doubtless the Menuthias of Ptolemy. The number of days' journey given by this author, when compared with that reached by the boats now navigating these seas, and with the details given by Arrian respecting the aspect and productions of Menuthias, are conclusive as to its identity with Madagascar. The Pyralaos or volcanic islands must be identified with the Comoro islands. Maçoudi mentions Madagascar under the name of the land of Djafouna, and Edriji, in his "Nozhat Almoschtak" marks it upon a planisphere (date 1153), under the name of Chezbeza, by the side of a group of islands which, from the accompanying description, are the Comoro islands. M. Grandidier has made a *fac simile* of this planisphere, the most ancient known map on which Madagascar is shown. The first planisphere which gave an exact idea of the position and configuration of this large island was that of Salvat de Pilestrina, dated 1511. The maps of Apres de Mannevillette (1770), and Owen (1825) gave the coasts with tolerable exactitude, but the disposition of the mountains, the river-courses and the forests were unknown previous to the explorations of M. Grandidier himself. Until 1871 all the geographies showed Madagascar as intersected from north to south by a great chain of mountains sending east and west ramifications, separated by wide valleys, while the entire area was forest-covered. The facts are widely different. The entire eastern part of the island is occupied by a much disturbed mountain

mass, the watershed of which is not very distant from the Indian ocean; while the forests form a continuous girdle, only a few leagues in width, concentric with the coast and surrounding a vast area which is entirely without trees, and in its mountainous portions, that is to say, throughout two-thirds of its extent, is even without shrubs. The western part of the island is flat.

Cosmos gives an account of Captain Crema's journey in Morocco in 1882 with a map which corrects many defects in previous maps, and supplies many omissions. In the same issue G. Bianchi gives an account of his explorations in the Gurageh territory in 1880, with a map of the Galla territory south and east of Shoa.

The Aruwimi.—It is known that the Congo, at the head of its bend to the north of the equator, receives a great tributary, the Aruwimi, from the north-east, but the course of this river is still unknown. A large river called the Welle, with numerous tributaries, the Gadda, Gurba and the considerable river Bomokandi, has been thought to be the Aruwimi, but Dr. Junker hopes to be soon able to adduce proof that it belongs to the system of the Shari, flowing into Lake Tchad, while he feels inclined to identify the Nepoko, a large river with numerous tributaries bordered by vast treeless swamps, with the Aruwimi of Stanley.

Asia.—*The Nan-schan Mountains*.—The explorations of Col. Przewalsky in the north-eastern part of Thibet have unraveled the complications of the mountain-chains of this region. The Kuen-luen mountains stretch, under various names, from Yarkand into the interior of China proper, but it is only in their western part that they form the northern boundary of the Thibetan highland, separating it from the low-lying desert of Tarim. Farther east the rim of this highland is double. The Tugus-daban connects the Kuen-luen with the colossal Altyn-tag to the east, and the latter is again connected with the still more easterly Nan-schan. Enclosed between the Kuen-luen and the northern mountains are the basin of the Koko-Nor and the ring-like plateau of Tsaidam. The Nan-schan consists of at least three parallel ranges and forms an alpine region of considerable width, broadest north and north-west of the Koko-Nor and at least forty versts wide in the meridian of Ssa-tcheon. Ssa-tcheon, situated in an oasis, is the chief town of the north-westerly prolongation of Kansu that extends between Mongolia and Thibet. Col. Przewalsky has given names to the subordinate ranges, one of which, the Humboldt, has summits at least 19,000 feet in height. Nowhere in the world is a greater contrast to be found than that between the two sides of this huge mountain rim. On the northern face of the Nan-schan extends a broad plateau 5000 to 7600 feet above the sea, with a vegetation of Ephedra, Haloxylon, Nitraria, Calligonum and *Artemisia campestris*, like that of the desert. The Nan-schan mountains are rich in gold, as are also the sands of the Dan-he river, which rises on their slope.

The Thousand Caves.— Col. Przewalsky, in his account of the Nan-schan mountains on the confines of Mongolia and Thibet, describes the "Thousand Caves" excavated by the Buddhists in a ravine lying between the sand desert and the mountains. These caves form two irregular rows, one above the other, excavated in the precipice. At the southern end a third row comes in. The lower row communicates with the upper by steps. Here, in the space of a verst, are many hundred caves, large and small, few of which remain uninjured. These caves were excavated under the Han dynasty. Walls and vaults were once covered with plaster and adorned with mosaics, and in some places remains of the larger images exist. Each of the smaller caves is from twenty-eight to thirty-five feet long, twenty-one to twenty-eight wide, and twenty-eight high. The larger caves have twice these dimensions, the figures in them are sometimes twice the natural size, and in their center stands a colossal figure upon a pedestal, surrounded by smaller figures. Two of the largest of these colossi are Da-fu-jan, eighty-five to ninety feet high, and some forty-five feet wide, with feet twenty-one feet in length, and forty-two feet apart between the great toes; and Dsho-fu-jan, which is about one-half these dimensions. In two of the caves there are upon the walks colossal idols in a recumbent position; one of these, called Schi-fu-jan, is surrounded by his seventy-two children. The head, the hands which are clasped over the breast, and the bare feet of this figure are gilded, and the garments striped with red. These figures are finished off with a mixture of clay and chopped reeds. At the entrances of the larger caves, and sometimes in the interior, are representations of heroes, often with grotesque or animal faces, and with swords, snakes, etc., in their hands. In one cave such a hero is mounted upon an elephant, while in another a similar figure rides upon a fabulous beast.

The Pamir.—The Proceedings of the Royal Geographical Society (March, 1884), give a map illustrating the Russian explorations in the Pamir, the "Roof of the World," and highest region of central Asia. The map is compiled from that of Dr. Regel and others, and includes the discoveries made by Captain Putiata, M. Ivanoff, and M. Bendersky, of the Pamir Expedition fitted out last year by the Russian governor of Turkistan. The upper courses of the Murghab, Great Pamir, and Khund, all tributaries of the Pandj, are clearly shown, and several lakes indicated. The Aksu is the head-stream of the Murghab.

Central Arabia.—M. C. Huber, already known from his travels in Central Arabia, is now at Haïl, the capital of Jebel-Schommar. Ibn Reschid, emir of this region, has recently defeated Abdallah Ibn Saoud, the heir to the Wahhabite throne. M. Huber, who was escorted from Damascus by three horsemen sent for that purpose, and is lodged in one of the finest houses of the capital, has collected much geographical information, and has obtained a

hundred new inscriptions. He is about to depart to determine the position of the mountain mass of Jebel Agée, and proposes to traverse the entire Hedjaz. The results of his first journey are in preparation for publication by the Geographical Society of Paris.

The Aral.—M. Konshin states as the result of his explorations that the immense depression of Sara-kamysh, in some places 280 feet below the Aral, formed in a geologically recent time one basin with that lake. The fossils of this depression are identical with species found in the Aral and Caspian lakes and show that its waters were brackish or salt. The lake had an outflow into the Caspian.

China.—M. Hosie, who has made a journey of nearly 2000 miles from Chung-King in Szo-chuan to Cheng-tu, capital of that province, and thence by Tali in Yunnan to Yunnan-Fu, returning by another route, states that the European maps of these districts are exceedingly defective, although fairly good native maps can be procured.

GEOLOGY AND PALÆONTOLOGY.

The Protoconch of Cephalopoda.—The accepted divisions of the Cephalopods have been founded by authors wholly upon characteristics of the adult form of the shell, whether straight, as in Orthoceras, curved, as in Cyrtoceras, coiled up with open whorls, as in Gyroceras, or with the whorls in contact, as in Nautilus. These modifications, together with the outlines of the aperture and other minor characteristics, have, heretofore, determined the group to which any given shell was referred.

The examination of the young of all the closely coiled Nautiloidea shows them to be as a rule uncoiled, and in the earliest stages simply arcuate as in the adults of the group of the Cyrtoceratites, and having a scar on the apex which represents the beginning of the stage in which the animal commences to construct the true or secondary shell. The young of all the Ammonoids have, on the contrary, with the marked exception of some palæozoic species and some *varieties of species*, closely coiled whorls at the corresponding stage of growth, and upon the apex is a tiny bag or embryo shell, which has been very appropriately called the protoconch by Owen.

In my Embryology of Cephalopods, Bulletin of Museum of Comparative Zoölogy, Cambridge, No. 5, Vol. III, the position was taken that the scar of the Nautiloidea showed that a protoconch had existed in the embryo of Nautilus, but had disappeared during the growth of the shell, the scar being uncovered by its removal. This supposition was endorsed by Professor Richard Owen, but rejected by Barrande, who insisted that the general absence of a protoconch was a fatal objection. There exists, however, on the apex of some Orthoceratites, an excrescence or

bulb of a withered and somewhat irregular and variable shape. De Koninck, in his magnificent work upon the "Calcaire Carbonifere de Belgique," curiously enough cites these very forms as the principal proofs against my conclusion, because in them the scar is absent. According to my examinations and drawings, however, the scar ought to be found in such examples underneath the bulb of the apparently complete apex, which is simply the withered and shrunken remains of the primitive protoconch. This was evidently originally a soft, embryonic shell, composed of conchiolin, and not of calcareous matter as in the Ammonoidea. I have seen and figured several examples in which a bulb was present on the apex and no scar visible, and one case in which the bulb (protoconch), had evidently been taken away, leaving the scar visible below, surrounded by the broken edges of the outermost shell layer, which formerly connected the apex with, and covered the protoconch. The external layer of shell and its longitudinal ridges from the apex up, on to the so-called plug of the cicatrix described by Barrande, have also been traced, and thus every point in the evidence appears to be complete, and the fact that the bulb is covered by a true protoconch continuous with the shell of the apex seems to be established.—*Alpheus Hyatt.*

Fossil Man in Mexico.—Dr. Mariano Barcena, director of the department of Geology and Palæontology of the National Museum of Mexico, recently discovered the facial and mandibular parts of a human skull in a hard rock not far from the city of Mexico. The specimen was found in a hard siliceous limestone near the border of Lake Texcoco, at some elevation above the level of the water of the lake. Overlying the bed of limestone, is a lacustrine deposit, which is similar to that made by the present lake, and contains the same mollusca, etc. Whether the limestone be a still more ancient deposit of the lake, has not yet been determined by Dr. Barcena, but the overlying deposit indicates the former wider extension of its waters. It is also evident that since the entombment of the human skull, both deposits have been elevated several feet, and separated from the part now under the lake by a fault. This was probably accomplished at the time of the projection of an eruptive hill near the locality. Dr. Barcena, from whom the above statements are derived, will shortly describe the characters of this interesting specimen.

Geology of Algiers.—*Tertiary.*—The three tertiary stages, say M. Peron, can usually be easily distinguished in Algiers, for they present themselves in isolated and independent masses. The systems of upheaval of the Pyrenees of Corsica and Sardinia, and of the western Alps, have all played an important part in Algiers, and have so separated the tertiary areas as to render their classification relatively easy. The eocene is in many places absolutely without fossils, and in most others offers nothing to the palæon-

tologist but immense numbers of nummulites. Sandstone is the chief constituent, but there are thick bands of claystones, flint, gypsum, etc. The total thickness cannot be less than 400 meters. This formation is the most important factor in the mountains of the Tell, and a multitude of summits are composed of the sandstones and nummulitic limestones. It is superposed on various formations, and is usually highly unconformable with the stratum on which it rests. The eocene appears in two interrupted belts parallel to the coast, one in the Tell, the second in the north of the high plateaux. It does not occur in the south, and is more developed in the east than in the west. The miocene, on the contrary, is most developed in the west, and, though frequently composed of rocks very similar to the eocene, can usually be distinguished by its highly fossiliferous character. In the department of Constantine part of the deposits are lacustrine or fluviatile. Miocene strata occupy large areas in the Tell, apparently filling depressions produced after the deposit of the eocene, and in the province of Oran they reach their highest development, and are rich in fossil echini.

The area occupied by the pliocene is much more limited, and is composed of some isolated lacustrine deposits in the province of Constantine, with perhaps certain belts in the Saharian region, and of small enclosed patches of marine origin filling depressions near the coast. The quaternary covers enormous areas, and belongs to different epochs. The strata are terraced in the valleys hollowed out during the quaternary period, or fill the great depressions of the high plateaux and of the Sahara. These are of lacustrine, fluviatile or continental origin, but marine beds occur in many spots along the coast from Tripoli to Morocco. The great superficial development of these beds in the plateaux and the Sahara, and the thickness they attain in the depressions, cause some to refer them to the upper tertiary, and some to believe them to be the work of a gradually drying-up interior sea. Several of the characteristic mammals have been found, but it cannot be said that these beds have been thoroughly explored.

The Carboniferous Flora of Rhode Island.—The following is a list, with descriptions of two new species, of such of the fossil Carboniferous plants of Rhode Island as are contained in the Museum of Brown University, Providence, R. I., and which have been sent me for identification, and of those which I have had opportunities to see in different collections, especially that of the Museum of Comp. Zoöl. of Cambridge, and of Mr. R. D. Lacoe of Pittston. Those from Valley Falls, R. I., have in part been collected by Mr. Thomas Battey, and those from Rhode Island, near Portsmouth, were collected by J. H. Clarke, Esq. A few species have been collected at Cranston, R. I., by Professor A. S. Packard.

A few species from the Rhode Island coal series were enumerated and figured by Dr. C. T. Jackson in his Report on the Geology of Rhode Island, published in 1840. A few others have been figured by Professor Teschemacher, in Boston Journ. Soc. N. H., Vol. v, Pl. XXXIV. The others are described and mostly figured in the U. S. Coal flora, Report P, of the second Geological Survey of Pennsylvania.

The following list embraces eighty-eight species, of which fifty-six are ferns:

FILICACEÆ.

Sphenopteris fuciformis, sp. nov.—Frond polypinnate; pinnæ linear or narrowly lanceolate, bipinnatifid; pinnules alternate, oblong, pinnately divided into simple, linear, obtuse or inflated at apex, open or reflexed segments.

The whole plant apparently originally soft, is deformed by compression. The main rachis is flat, smooth, like all the parts of the plant, 2^{mm} broad; that of the lateral pinnæ is half as broad; that of the pinnules a little more than $\frac{1}{2}^{mm}$ in diameter; the laciniæ 3^{mm} long, $\frac{1}{2}^{mm}$ broad or a little more, are open and somewhat curved back, all simple and entire.

This species closely resembles *Sphenopteris laxa* St., Fl. d. Vorw. I, Pl. 31, fig. 3, described in II, p. 58; and also *S. elegans* Brgt., differing essentially in the laciniæ alternate, simple not bifid nor forked at the apex.

Sphenopteris pseudo-murrayana Lesq.—Upper part of pinna.
Sphenopteris gravenhorstii Brgt.
Sphenopteris chærophylloides Brgt.
Sphenopteris cristata St.
Sphenopteris elegans Brgt.
Sphenopteris hœninghausii Brgt.
Sphenopteris tridactyites Brgt.
Neuropteris cordata Brgt.

Neuropteris hirsuta Lesq.—With a Cyclopteris, round or reniform large leaflet, and also small round basilar ones; all detached from the rachis and representing the same species.

Neuropteris agassizii Lesq.
Neuropteris crenulata? Brgt.
Neuropteris desorii Lesq.
Neuropteris germari Goepp.
Neuropteris heterophylla Brgt.
Neuropteris tenuifolia Brgt.
Cyclopteris species.
Dictyopteris scheuchzeri Hoffm.—As figured by Roehl.

Callipteridium sp. nov.? or variety of *Alethopteris urophylla* Brgt.—Main rachis somewhat large, $3–4^{mm}$ in diameter; ultimate pinnæ very long, close, narrow, nearly at right angles; parallel; pinnules slightly inclined upward, or open, subopposite, separated to the base, connate at the base only, oblong-lanceolate, obtuse or blunt pointed, gradually narrowing from the base upward; middle nerve inflated in the lower part, effaced above the middle or under the apex; lateral veins oblique, somewhat curved back, forking once. The pinnæ are very long, the longest preserved is nearly 12^{mm} long, broken like all the others below the apex so that no ultimate pinnule is observable; they are comparatively narrow, 15^{mm} at base; only 5^{mm} at the point where they are broken; the veins are not very distinct, divided like those of *Alethopteris urophylla* Brgt., which the species resembles in the form of the pinnules. As the ultimate pinnule, which in the European species is very long and linear lanceolate, is not observable, the identification is not possible. The difference is marked in the narrower pinnæ, the more pointed pinnules and the coriaceous texture.

Odontopteris alpina Gein.—Large leaflets.
Odontopteris alata Lesq.
Odontopteris brardii Brgt.
Odontopteris deformata Lesq.
Odontopteris neuropteroides Newby.
Odontopteris patens Lesq.
Pecopteris polymorpha Brgt.
Pecopteris acuta Brgt.
Pecopteris abbreviata Brgt.
Pecopteris cyathea Bgt.
Pecopteris miltoni Brgt.
Pecopteris oreopteridis Schlt.
Pecopteris candolliana Brgt.
Pecopteris dentata Brgt.
Pecopteris arborescens Brgt.
Pecopteris aspidioides Brgt.
Pecopteris clarkii Lesq.
Pecopteris erosa Gutb.

Pecopteris pennæformis Brgt.
Pecopteris platyrachis Brgt.
Pecopteris quadratifolia Lesq.
Pecopteris (*Goniopteris*) *unita* Brgt.
Pecopteris (*Goniopteris*) *arguta* Brgt.
Pseudopecopteris cordato-ovata (Weiss.) Lesq.
Pseudopecopteris nervosa (Brgt.) Lesq.
Pseudopecopteris dimorpha Lesq.
Pseudopecopteris pluckneti (Brgt.) Lesq.
Pseudopecopteris anceps Lesq.
Pseudopecopteris muricata (Brgt.) Lesq.
Pseudopecopteris spinulosa Lesq.
Rhacophyllum affine Lesq.
Rhacophyllum clarkii Lesq.
Rhacophyllum filiforme Gutb.
Rhacophyllum filiciforme Gutb.
Rhacophyllum fimbriatum Lesq.
Rhacophyllum hirsutum var. *affine* Lesq.
Rhachiopteris sp.—Rachis of fern.

Calamarieæ.

Calamites suckowii Brgt., var. *nodosus* St.—A fine specimen.
Calamites approximatus Schloth.—A twisted fragment.
Calamites ramosus Brgt. — Crushed branches.
Calamites cistii Brgt.
Asterophyllites sublævis Lesq
Asterophyllites equisetiformis Brgt.
Asterophyllites grandis St.
Asterophyllites rigidus Gein.
Annularia longifolia Brgt.—A large form.
Annularia calamitoides Schp.
Annularia inflata Lesq.
Annularia sphenophylloides Brgt.
Sphenophyllum oblongifolium Germ.
Sphenophyllum schlotheimii Brgt.
Sphenophyllum emarginatum Brgt.
Sphenophyllum filiculme Lesq.
Sphenophyllum longifolium Germ.

Lycopodiaceæ.

Lepidodendron longifolium Brgt.—Tuft of leaves.
Lepidodendron dichotomum St.—Leaves.
Lepidodendron (Bergeria) *quadratum* St
Lepidodendron aculeatum St.
Lepidophyllum lanceolatum Brgt.
Lepidophyllum fallax Lesq.
Lepidophyllum hastatum Lesq.
Lepidophyllum majus Lesq.
Lepidophyllum oblongifolium Lesq.
Lepidophyllum stantoni Lesq.
Lepidophyllum tumidum Lesq.
Stigmaria ficoides St.—Leaves obliquely crossing clay, and specimens of other leaves.

Cordaiteæ.

Cordaites borassifolius Unger.
Cordaites diversifolius Lesq.

—*Leo Lesquereux.*

Geological News.—*Carboniferous.*—A large and unusually complete example of Megalichthys was recently found near Leeds. The length is three feet eight and one-half inches, but about six inches of the tail is missing. The features of this fossil, Professor Miall states, confirm the opinion long ago expressed by Pander and Huxley as to the near affinity of this fish to Osteolepis and Diplopterus.

Jurassic.—Mr. J. W. Davis (*Ann. & Mag. Nat. His.*, June, 1884) describes *Lissolepis serratus*, a palæoniscid fish, found at Lyme Regis, England. The jaws are very long, the gape wide, clavicles are well-developed and the head is protected by sculptured surface-enameled plates.

Cretaceous.—M. Capellini, in a communication addressed to the Paris Academy of Sciences, shows that, in the Apennines as well as in the Pyrenees, the Inocerami, fuci, and worm tracks of the strata known as "Flysch" are identical with those of the cretaceous rocks of Liguria and Tuscany. He recommends that the term "Flysch" be dropped from geology.——Twenty-two years ago in the scaglia (cretaceous) of Verona, the remains of a great

fossil animal were found. The report spread that it was a fossil man, and the proprietor asked an enormous price for it, until he was at last convinced it was a reptile. It then fell into the hands of Dr. Capellini, who found it to be a tortoise of the Sphargis group.——M. A. Gaudry recently presented to the Paris Academy of Sciences a note upon a new sirenian found in the Paris basin, and named by him *Haliterium chongueti.* It occurs in the *Ostrea cyathula* marls, and must not be confounded with *H. schinzi.*

Trias.—At a recent meeting of the Royal Geological Society Professor Owen described *Rhytidosteus capensis*, a labyrinthodont amphibian from the Trias of the Cape of Good Hope. The specimen consisted of the anterior part of the skull with a portion of the mandible attached.

Tertiary.—E. T. Newton has recently written upon the antelope remains from the newer Pliocene beds of Britain, and has described a gazelle which, though near to *G. bennettii*, he regards as new, and entitles *G. anglica.*

Quaternary.—M. G. Rolland has presented to the Academy of Sciences of Paris a series of objections to the theory of a quaternary Saharian sea. One of these is the absence of any true bed of marine fossils in the recent strata of the Sahara, since *Cardium edule* is rather a brackish-water than a marine species. A second objection is derived from the levels. M. Rolland believes that from the commencement of the tertiary the Sahara formed a continent except in the relatively narrow space in the north-east, occupied by the eocene sea; at the end of the miocene all the north of Africa had definitely emerged, and since that epoch the contour of the southern coast of the Mediterranean has not sensibly varied. Both M. Rolland and M. Pomel consider the quaternary formation of the Sahara as continental in origin, and deposited by diluvial waters in an age when the Sahara was abundantly supplied with rivers.

MINERALOGY.[1]

New Minerals.—(1). *Aimafibrite*[2] (Igelström).—Among the manganese minerals of Nordmark, Sweden, are several new species, described by Igelström and others. Aimafibrite, so called from its blood-red color and fibrous structure, is a basic hydro-arseniate of protoxide of manganese with a little protoxide of iron, magnesia and lime. Its crystalline form is an orthorhombic prism, the crystals radiating from a point and forming globules. It occurs in globules about a centimeter in diameter, which are made up of radiating fibers. It is soluble in acid, gives water in

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Bull. Soc. Min. de France, VII, 1884, p. 121.

the tube, fumes of arsenic on charcoal, readily melts without decrepitation and gives decided reactions for manganese.

Analysis gives:

As_2O_5	MnO	FeO	MgO	CaO	H_2O	
29.94	46.98	4.65	2.00	1.50	14 93	= 100

Formula: $2(3MnO\ As_2O_5) + 7MnO\ HO + 6HO$

(2) *Aimatolite*[1] (Igelström).—At the same locality, associated with the last, is a blood-red transparent mineral having the appearance of precious garnet. It occurs always in crystals and is imbedded in limestone. The crystals are from one to two millimeters in diameter, and according to an investigation by Bertrand, occur in rhombohedrons, and have a perfect basal cleavage. It has the same blowpipe characters as aimafibrite.

Composition:

As_2O_5	MnO	FeO	MgO	CaO	H_2O	
25.70	34 55	13.05	8.10	2.52	16.08	= 100

Formula: $2(3MnO\ As_2O_5) + 8MnO\ HO + 6HO$

(3) *Allaktite*[2] (Sjögren).—This is another arseniate of manganese from the same locality. It is of yellow to green color and occurs in flat tabular crystals, belonging to the monoclinic system. Crystallographically it is regarded as related to the vivianite group of minerals. It has a hardness of 4 to 5, and spec. grav. 3.83–3.85.

Composition:

As_2O_5	MnO	FeO MgO CaO	H_2O	
28.57	61.92	1.15	9.01	= 100.65

Formula: $2(3MnO\ As_2O_5) + 8MnO\ HO + HO$

For comparison with the three formulæ here given that of a fourth hydro-arseniate of manganese from the same locality is added. The formula of chrondroarsenite is $2(5MnO\ As_2O_5) + 5HO$. Of these four minerals the least basic is chrondroarsenite, and the most basic, aimalolite.

(4) *Bröggerite*[3] (Blomstrand).—This mineral is yet another from the same prolific locality. It is an uranium mineral allied to uraninite. It occurs in black crystals of the isometric system and in crystalline masses. The octahedron is the common form. Hardness 5–6; specific gravity 8.73.

Composition:

UO_3	UO_2	PbO	ThO_2	Ce_2O_3	Y_2O_3	FeO	CaO	SiO_2	H_2O	
38.82	41.25	8.41	5.64	0.35	2.42	1.26	0.30	0.81	0.83	= 110.12

(5) *Colemanite*[4] (Evans).—J. T. Evans has given this name

[1] Bull. Soc. Min. de France, VII, 1884, p. 121.

[2] Geol. För. Förh. Stockholm, VII, 1884, p. 109.

[3] Geol. För. Förh. Stockholm, VII, 1884, p. 59.

[4] Bull. Calif. Acad. Sciences, No. 1, p. 57.

(called after W. T. Coleman) to a hydrous borate of calcium from Southern California. It is described as possessing monoclinic crystallization; $I \wedge I = 108\frac{1}{4}°$. Luster vitreous to adamantine, often splendent. Cleavage clinodiagonal, perfect, affording readily thin, smooth and polished laminæ. Hardness 3.5 in the amorphous to 4.25 in the crystalline variety. Specific gravity 2.428. Colorless, transparent, sub-translucent to milky. Rather brittle. It decrepitates violently and then sinters in the blowpipe flame. Readily soluble in acid, giving abundant flakes of boracic acid. Admixtures of soda were found even in the clearest crystals.

Disregarding the soda the composition is:

B_2O_3	CaO	H_2O	
[50.98]	27.18	21.84	= 100

The formula $2CaO\ 3B_2O_3 + 5H_2O$ is deduced.

It is closely allied to priceite and is perhaps identical with it. Analysis of the massive mineral are stated to give results closely agreeing with the formula of priceite.

(6) *Manganostibite*[1] (Igelström).—This mineral occurs at Nordmark, Sweden, with other manganese minerals in primitive limestone (Laurentian). It occurs in small black grains, resembling magnetite or hausmannite. It is compact with difficult cleavage and with greasy luster. It is supposed to be orthorhombic. Before the blowpipe it is infusible, and with carbonate of soda gives fumes of arsenic and antimony. Reactions for manganese are readily obtained. It is perfectly soluble in chlorhydric acid, but in nitric acid gives insoluble oxide of antimony.

Composition:

Sb_2O_5	As_2O_5	MnO	FeO	CaO	MgO	
24.09	7.44	55.77	5.00	4.62	3.00	= 99.92

Formula: $5MnO\ (Sb\ As)_2\ O_5$

(7) *Salmite*[2] (Prost). — This is described as a manganesian variety of chloritoid, occurring in irregular masses at Vielsalm, Belgium. Color gray; hardness 5–6; specific gravity 3.38.

Composition:

Si_2O	Al_2O_3	Fe_2O_3	FeO	MnO	CoO	MgO	CaO	H_2O	Quartz	
19.14	33.66	3.38	13.05	7.14	0.04	1.79	0.30	6.32	15.06	= 99.88

(8) *Utahite*[3] (Damour).—Damour has proposed this name for a hydrous basic sulphate of peroxide of iron, which occurs in minute hexagonal crystals of micaceous structure in the mines of Eureka Hill, Juab county, Utah. The specimens were taken to France by Ochsenius, and first described by Arzuni, but named by Damour. The crystals of this mineral are of a yellowish-brown color and so small as hardly to be visible to

[1] Bull. Soc. Min. de France, VII, 1884, p. 120.

[2] Geolog. Soc. Belge.

[3] Bull. Soc. Min. de France, VII, 1884, p. 126.

the naked eye. They form a crust on compact quartzite. They occur in regular hexagonal prisms and have a micaceous basal cleavage. They are optically uniaxial, and belong, therefore, to the hexagonal system.

Heated in a matrass, acid water is disengaged, and the mineral becomes red. In the blowpipe flame it fuses to a black scoria. It is attacked by chlorhydric acid heated to the boiling point, but not by nitric acid.

Analysis gave (Damour):

SO_3	AsO_5	Fe_2O_3	H_2O
28.45	3.19	58.82	9.32

Formula; $3Fe_2O_3\ 3SO_3 + 4H_2O$

FLEXIBLE SANDSTONE.—In a note in the June NATURALIST on flexible sandstone from Pennsylvania, its flexibility was regarded as due to its decomposition. As regards the itacolumite of Brazil, Mr. J. C. Branner, formerly of the Geological Survey of Brazil, writes to us as follows:

"I once spent a year in the diamond region of Minas Geraes, Brazil, where I had the best of opportunities for observing the itacolumite, which is there the country rock. In one place a canal several miles in length was being cut by a mining company, and in many places through this flexible sandstone. Owing to its flexibility it was very difficult to blast, for instead of breaking out in large fragments, the rock would often yield and bend like so much leather, and only a few fragments would be broken off about the mouth of the hole. On account of this difficulty in blasting, it was frequently necessary to cut it out with the pick. In one place the rock was cut through to a depth of about twenty-five feet from the surface, and yet at the bottom of this cut the decomposition and flexibility was almost as marked as near the surface. But in the deep gold mines in the itacolumite this flexibility was never found very far beneath the surface. I regret to say that I made no exact measurement of the depths at which it ceases. I may say, however, that at a distance of about a hundred feet from the surface this sandstone was no longer yellowish or light brown, but was of a somewhat leaden color, and that its characteristic flexibility had disappeared entirely.

"Again at a certain stage of decomposition more advanced than that indicated by flexibility, this sandstone simply fell apart when broken in the hand, or could be cut through more easily than ordinary earth. It would be interesting to study the depth of decomposition of itacolumite by noting the depth at which it ceases to be flexible."

MINERALOGICAL NOTES.—A union has been effected between the Mineralogical Society and the Crystallogical Society of Great Britain. The Crystallogical Society brings with it several mineralogists of high attainments, who will be likely to make the

Mineralogical Magazine a more valuable journal than it has been heretofore. Several of the articles in that journal have been more notable for quantity than quality. Like the other English societies the Mineralogical Society has gravitated to London, although originally intended as a peripatetic society.——Native lead has been observed in cavities in red carbonate of lead from Maulmain, Burma, India. It occurs in small masses associated with minute crystals of white cerussite. The bright red color of the cerussite containing the native lead is probably due to an intimate mixture of minium.——H. A. Miers, of the British Museum, has measured with a Fuess goniometer several crystals of the rare mineral *meneghinite*. It occurs in slender needles, and the end planes are very small. The needles are deeply striated or channeled, making measurements difficult. A number of new faces were observed, and the crystals determined to be *orthorhombic*, with the axial lengths a : b : c = 1.89046 : 1 . .68664.——Associated with galena, and filling cavities in quartz, an interesting form of *kaolinite* occurs in Ouray county, Colorado. The mineral appears as a mass of glistening white scales visible to the naked eye, and under the microscope show as perfect transparent crystals having well-defined pyramidal planes. —— Dr. M. E. Wadsworth has issued a descriptive catalogue of one hundred thin sections of American and foreign rocks for the use of students of microscopical lithology. The collection consists of European rocks described by Rosenbusch, Zirkel and several other European lithologists, together with a number of American rocks described by Dr. Wadsworth. This appears to be the most complete and systematic collection for students that has yet been arranged.

BOTANY.[1]

THE FERTILIZATION OF GIANT HYSSOP (LOPHANTHUS NEPETOIDES).—The giant hyssop has greenish-yellow flowers about one centimeter long. The inner stamens are the longest and are the first to appear on the opening of the bud (Fig. 1). While the outer or shorter pair of anthers develop and take a position

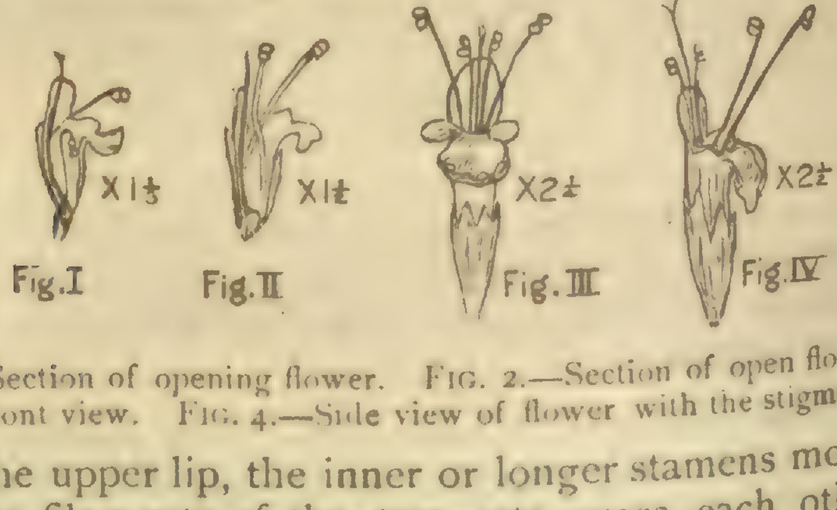

FIG. 1.—Section of opening flower. FIG. 2.—Section of open flower. FIG. 3.—The same, front view. FIG. 4.—Side view of flower with the stigma-lobes mature

close to the upper lip, the inner or longer stamens move forwards so that the filaments of the two sets cross each other (Fig. 2). The inner stamens therefore are near the lower lip of the corolla

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

and diverge considerably, while the outer pair stand erect and close together near the upper lip (Fig. 3). During this time the stigma lobes are closed and the style has grown to the length of the longest stamens and assumed a position almost erect, inclined rather to the back of the flower (Fig. 4). The flowers are therefore proterandrous, but not purely so. In the bud all the stamens and the style curve forwards under the lower lip.

The distinguishing feature between this and the ordinary Labiatæ consists in the crossing of the filaments, by means of which the longer inner stamens take the appearance of being the outer stamens, and in the curvature of the style. The style of the Labiatæ usually bends forwards at maturity, so as to meet the body of the visiting insects. In this species it seems to bend backwards, often much more than represented in Fig. 4. In truth, however, this bending occurs before maturity, and either remains so at the time the stigma matures, or the curvature forwards is rather slight, leaving it behind a line vertical to the individual flowers.

The visiting insect begins at the lower part of the interrupted spikes, receiving pollen on its sides from the longer stamens, and under its body as it crawls over the smaller ones to the next flower, at the same time leaving pollen on the stigma lobes. The flower has accommodated itself to the crawling habit of its visitor.

To explain more fully, the flowers of most Labiatæ are so arranged as to necessitate the entrance of the insect from one particular position, compelling them generally to leave the plant each time and thus fly to the individual blossoms it chooses to visit. Hence the curvature of the style forwards is adapted to touch the insect in one particular spot each time. In the case of Lophanthus the flowers generally are blossoming throughout the whole length of the spike at the same time, and from the shortness of the tube and lips of the flowers the bees readily crawl from one flower to the next in a rather indefinite fashion. The backward curvature is here the best adapted to the circumstances since it does not offer any unnecessary resistance to the body of the insect. Still the arrangement of the flower must be considered as of a low degree of specialization.—*Aug. F. Foerste, Granville, Ohio.*

The Injuriousness of Porcupine Grass.—Our inquiry as to whether porcupine grass has ever been known to injure domestic animals in this country is answered as follows by Dr. M. Stalker, the State veterinarian of Iowa:

You ask whether the fruits of porcupine grass (*Stipa spartea*) are ever a source of inconvenience or injury to living animals? This may be very emphatically answered in the affirmative. In many of the north-western counties of Iowa this grass grows in

the greatest profusion, and during the latter part of June, the season for maturing and consequent falling of these spines. they are the occasion of much annoyance and in some instances the death of domestic animals. Only such animals as are covered with wool or a thick growth of long hair are seriously inconvenienced. Sheep suffer most. The spines readily find a lodgment in the wool, and after burrowing through it frequently penetrate the skin and bury themselves in the flesh. A large number of these barbs thus entering the tissues of the body produce an amount of irritation that is sometimes followed by death. I have seen large numbers of these imbedded in the skin and muscular tissues of shepherd dogs that were covered by a thick growth of soft hair. These sagacious animals frequently exhibit the greatest dread at being sent into the grass during the season of danger."

STRUCTURE OF THE FRUIT OF PORCUPINE GRASS.—The mature "fruit" of this interesting grass consists of a narrow cylindrical grain (Fig. 3) about 1^{cm} long and 1^{mm} thick. This is enclosed in

FIG. 1.—Entire "fruit" of porcupine grass, natural size, showing the twisted awn. FIG. 2.—Lower portion of the same, enlarged. FIG. 3.—Grain of same, enlarged.

the two hard persistent palets, the larger of which bears a tough awn from 12 to 16^{cm} long (Fig. 1). This larger palet completely encloses the smaller one, and at maturity it is quite difficult, with

the naked eye, to make out its overlapping margins. Its lower portion is densely covered with stiff hairs (Fig. 2), as is also the short pedicel upon which the whole flower rests. This pedicel is tapering, curved and greatly indurated, and at the maturity of the fruit it separates at its lower end from the rest of the axis. At its point of separation, which now becomes the lower end of the "fruit," it is very sharp, readily piercing clothing or even the skin of the back of one's hand. The hairs prevent the withdrawal of the point, and tend to cause it to enter more deeply.

The awn, which is at first straight, is channeled on two nearly opposite sides. Both the channels, as well as the general surface of the awn, are provided with short stiff hairs which act as barbs. At maturity the awns begin twisting throughout a little more than their lower half as shown in Fig. 1, but the upper portion remains straight or nearly so, and soon becomes bent at nearly a right angle to the twisted part. This twisting facilitates the entrance of the barbed pedicel and palets into the soil, and, as lately pointed out, into the skins of sheep, dogs and other domestic animals. The greater weight of the lower end of the whole "fruit" makes it, before the twisting of the awn, an excellent dart, and on falling out of the glumes it invariably strikes point downwards.—*C. E. Bessey.*

AN ABNORMAL FUCHSIA BLOSSOM.—I have lately had an opportunity of examining an abnormality of the calyx of a fuchsia, which seems to allow of certain important deductions.

It consists of the partial modification of one of the sepals into a foliage-leaf. A distinct midrib extends up the center of the sepal, which, on one side, is of the color and structure usual in the sepals of the fuchsia, while the other half is exactly similar to the half of a foliage-leaf of the same plant, presenting a green color, the toothed margin and the ordinary venation, being also the same width as half a foliage-leaf, and thus much broader than the portion on the other side of the midrib. Accompanying this modification there is a partial separation of the sepal from the calyx-tube. The unmodified half is adherent to the adjacent sepal, the leaf half only being separated and modified so as to represent below a leaf-petiole. This separation extends down to the base of the calyx-tube, and even to the base of the green receptacle below this.

Abnormalities similar to this seem to be of not uncommon occurrence. Among others Arndt (Botan. Jahresb., 1878) describes a case in which the limbs of the calyx were some half, others altogether green, the margins being toothed; Liebe (Botan. Jahresb., 1880) one in which the sepals were transformed into long-petioled foliage-leaves; and Buchenan (Botan. Jahresb., 1880) besides stating a case that came under his own observation, in which two of the sepals had become transformed into foliage-

leaves, springing apparently from the base of the receptacle, and having in their axils each a stamen, cites a case observed by Suringar in which one sepal with the two stamens opposite it became separated from the flower in a similar manner, and also one observed by Magnus in which all the sepals were transformed into foliage-leaves and separated as far down as the base of the receptacle, similar, accordingly, to the condition observed by Liebe.

Besides supporting the now universally accepted theory of the foliar nature of the sepals, the above instances and the one I have observed strengthen a supposition made by Magnus (Botan. Jahresb., 1879) after a study of two monstrous orchids, that in this order, as well as in the fuchsia, the green enlargement found below the floral leaves is not formed by the hollowing out of the axis, nor yet of carpellary leaves enclosed by an enlargement of the axis, but is an organ of a foliar nature. In other words, in the case of the fuchsia the dilatation is formed by the union of the bases of the petioles of the calycine leaves with each other and with the ovary, and therefore consists of two portions—in the interior the ovary and on the exterior the coalesced petioles. The term *receptacle* applied to it above is accordingly not correct, but was employed for convenience.

Another point indicated is, that the calyx-tube is *not* formed by the coalescence of those parts of the sepals which correspond to the petioles of foliage-leaves, the limbs representing the lamina, but consists partly of both petioles and laminæ. This was very evident in the case I examined, where the abnormal part was half sepal and half foliage-leaf, and therefore permitted a direct comparison. How far this may hold good in other cases in which the calyx (or even the corolla, as in the Primulaceæ and Caryophyllaceæ, for instance) is composed of a well marked tube and limbs, or parts corresponding to them, I have not had opportunity to determine.—*J. Playfair McMurrich, Guelph, Canada.*

Botanical Notes.—The June *Torrey Bulletin* contains, among other articles of interest, one on the may-apple, by Aug. F. Foerste, devoted mainly to structure and development. Some odd abnormalities are figured. Many of these, however, were figured and described by Professor T. C. Porter in the *Botanical Gazette*, in 1877 (Vol. II, No. 9). In this connection we may record the fact, that in Central Iowa this year many colonies of may-apples were found with distinctly *pink* flowers.——The Table Alphabetique of Henri Van Heurck's Synopsis des Diatomées de Belgique has just been received by American subscribers.——Fascicles I and II of Luerssen's "Farnpflanzen oder Gefassbündelkryptogamen" (being parts of the third volume of the new edition of Rabenhorst's Kryptogamen-Flora) has lately appeared. It promises to be a work of great interest to pteridologists.——

Oberlin College is fortunate in coming into the possession of the extensive collection of plants made by Dr. Beardslee, of Painesville, Ohio.——In an important paper read before the American Philosophical Society, Oct., 1883, and printed May 12, 1884, John C. Branner discusses the course and growth of the fibro-vascular bundles in palms. He reviews at length the various theories which have been held as to the course of the bundles in the palms, a subject well known to be surrounded by many difficulties. The discussion is based upon direct personal observations and study of a large number of specimens of no less than seventeen different genera.——The long looked-for Manual of Mosses, by Lesquereux and James, has at last been issued by Cassino & Co., of Boston. An adequate notice will appear soon. ——Wm. Boott describes several new sedges in the June *Bot. Gazette*.——In the same number the announcement appears that Professors Coulter and Barnes are engaged in a special study of the North American species of the genus Cyperus, and desire to receive specimens. "Loaned specimens will be retained for as short a time as possible, and carefully returned."——The "Questions on botany," prepared by Professor Spalding for the use of students who have attended the general lectures on botany delivered in the departments of pharmacy and medicine in the University of Michigan, indicate that in another of our medical schools the importance of biological botany is fully realized ——Mr. R. M. Christy read a paper recently before the Linnean Society of London on the power of penetrating the skins of animals possessed by the seed of *Stipa spartea*. "Inquiry among butchers and others showed conclusively that large numbers [of these seeds] were often found beneath the skin of sheep, especially about the shoulders." This grass is abundant in the Mississippi valley (where it is known as Porcupine grass), and we have been familiar with it for years, but have never before heard of its penetrating the skins of animals. Has this been noticed by NATURALIST readers?

ENTOMOLOGY.

LIFE-HISTORIES OF SOME GEOMETRID MOTHS.—These and other unpublished notes on Lepidopterous larvæ have been prepared in connection with work on our forest trees done for the Entomological division of the U. S. Department of Agriculture, and to be incorporated in the fifth report of the U. S. Entomological Commission.

Aplodes coniferaria, n. sp.—We have reared six moths from curious 14-flapped larvæ found feeding in August on the fir and hemlock, and described in Bulletin VII, U. S. Ent. Comm., p. 238, and referred by us to Aplodes. The caterpillar is dull brick-red, with seven pairs of broad dorsally situated flat flaps on each side. It bears a striking resemblance to the small reddish twigs of the fir with the leaf scars.

From the 4th to the middle of September the caterpillars made between the twigs, a loose, slight, open cocoon of bits of small twigs and leaves, held together by silk, within which the pupæ rested through the winter.

The pupa is of the usual form, rather slender, brown, the abdomen bright brick-red above between the wing-covers; the end horn-brown and mottled; there is a blackish dorsal line and a dark stripe along the antennæ and veins of the wing, the branches being spotted with black. In another specimen the wing-covers were red and the body, including abdomen, horn-colored; the terminal spine is short, moderately stout, with eight unequal curved slender spinules. Length 9–10^{mm}.

Walsh's description of the larva of *Aplodes mimosaria*, which he bred from the oak, is too brief for comparison, but our specimens do not disagree with his diagnosis, though we have never found it on the oak, but frequently on the coniferous trees mentioned.

Six specimens, two of them males, issued from the chrysalids in the breeding box, in Providence, between April 20th and 25th. They were all of uniform size, the wings expanding about 25^{mm}. They differed but slightly from *A. mimosaria* though much smaller; compared with one of the latter the hind wings are more angulated, while the outer white line on the same wings is less bent in the middle. The lines on the fore wings are as in *A. mimosaria*, but vary in distance apart. The head and abdomen are marked as in *A. mimosaria;* the male hind tibiæ are as in that species. It differs decidedly from the two other species of its size, *A. approximaria* and *latiaria*.

On sending specimens to Mr. J. A. Lintner, to compare with his types of the species in his possession, he kindly writes as follows:

"Differs from *mimosaria* in the outer line of front wings being nearer to the margin, and the inner line being angulated on the submedian instead of curved. The outer line of secondaries is nearer to the margin than in *mimosaria*, and is more regular.

"It approaches nearer to *latiaria*, but the two lines are more approximate, and the inner line is more angulated on the submedian. It also has an inner line on the secondaries which *latiaria* has not."

Endropia textrinaria.—The caterpillar was found on the white oak at Providence, Oct. 7th. The body is rather slender, the head wider than the segment behind, rounded, rather deeply bilobed, swollen on each side of the apex of the clypeus; the latter edged with dark brown, forming a V-shaped line on the front of the head. The prothoracic segment is normal, while the mesothoracic segment is much swollen on each side, the rounded swellings connected by a dorsal curved ridge. On the metathoracic segment is a small transverse ridge, next to that on the meso-seg-

ment. On the hinder part of the 3d abdominal segment is a large double dorsal dark knob-like hump. On the 6th is a conspicuous dark transverse rounded ridge, enlarged and higher at each end. The 8th segment has large warts, and there are also large warts on the sides of segments 7–10. The supra-anal plate is triangular but short, with four hair-bearing warts above and four at the end. Anal legs large and broad. The short penultimate segment has a transverse row of eight large warts; these warts are obsolete on the front half of the body.

The body is of exactly the color of an oak twig, being dark gray shaded with light, and of the same color beneath as above; while the knotted appearance of the segments behind the head and in the middle of the body assist in the deception, the caterpillar being remarkably like a bit of oak twig. The anal conical dorsal tubercles are large and distinct.

Oct. 10 it began to spin a thin slight web at the bottom of the breeding box, and the pupa appeared Oct. 12.

The pupa is 15^{mm} in length, light horn-brown, the wing-covers dull brick-red; antennæ and limbs striped with black. The spiracles are prominent and black. The terminal spine ends in two long slender straight sharp acute spinules.

The moth appeared in the breeding box in May.

Paraphia deplanaria.—The caterpillar of this moth was found at Brunswick, Me., June 23d, on the fir. The body is cylindrical with no tubercles, and in color and appearance like a bit of a fir twig. Head rounded, somewhat bilobed, greenish, mottled and finely spotted, especially on the vertex on each side, with reddish-brown. Body reddish-brown, washed with greenish, and with a row of lateral irregular dark blotches. Length 22^{mm}.

The pupa was found June 28, and is of the usual dark tan-brown color, rather stout; the moth appears about July 8–10.

Tetracis lorata.—The moth was bred from a large twig-like caterpillar found on the hemlock at Brunswick, Maine, Aug. 25. Head flattened, square in front but not notched, slightly full on each side of a slight median impressed line. Pale gray, with a diffuse straight vertical band on each side, the middle being clear whitish gray. These dark latero-frontal bands and the pale gray median band are continued on to the prothoracic segment. The median whitish band is continued on to the meso-thoracic segment, but forms there two linear parallel white thread-like lines enclosing a linear brown median line; on each side of this ring, directly behind the prothoracic spiracle, is a large rough tubercle; the granulations coarse and prominent; white on the sides, above tawny-brown. On the 1st and 2d abdominal segments is a pair of swollen infra-spiracular rounded tubercles, concolorous with the body. The body is dull reddish-brown. The two piliferous warts are connected and converted into a transverse tubercle, becoming larger towards the 5th abdominal segment; the

tubercles behind rather large but not connected. From the 5th abdominal segment to the end of the supra-anal plate extends a black median line. Along the sides of the abdomen, on segments 2–5, is a lateral raised short brown line edged below with pale gray; these are situated in front of the spiracles. Below are three large tubercles on each segment, and there is a tubercle beneath. Hence the caterpillar represents a large rough twig, with leaf-scar-like tubercles. Anal plate sharp, triangular, tuberculated. Anal legs large. Length 38$^{mm.}$

The pupa is rather thick; the body in front, including the wings, horn-brown, speckled with blackish; abdomen reddish-brown. Spiracles distinct black. Terminal spine large, ending in two long straight acute spinules. Length 17$^{mm.}$

The moth appeared in the breeding box April 25. *Tetracis crocallata* feeds on the sumac, according to Mr. Saunders.

Metanema quercivoraria.—This was raised from the oak, but the larva unfortunately not described. The pupa is rather slender, reddish horn-brown; spine acute, large and flat. Length 13$^{mm.}$ The moth issued May 3. Several were taken at Keene Flats, Adirondacks, June 12, in a locality where no oak trees were seen.—*A. S. Packard.*

Bombus plundering different species of Plants.—On page 20 of Mr. Ogle's translation of Dr. Kerner's interesting treatise on "Flowers and their unbidden Guests," the author, after discussing the fertilization of the European species of Pedicularis by *Bombus montanus*, says: "It appears that the humble bees always devote themselves at one time to the plunder of one species of plants," to which the translator adds: "It is curious that a similar observation as to the habits of bees should have been made by Aristotle, 'a bee,' he says (H. An., IX, 40), 'on any one expedition does not pass from one kind of plant to another, but confines itself to a single species, for instance, to violets, and does not change until it has first returned to the hive.'"

In the light of the above, a few observations I have recently made on the subject may be of interest. In five instances I saw a large species of Bombus fly from the flowers of the common lousewort (*Pedicularis canad nse*) to those of the vetch (*Vicia americana*) and *vice versa*. In another instance a Bombus went from a blue hyacinth (*Hyacinthus orientalis*) to a columbine. Another went from the flowers of a small Solomon's seal (*Polygonatum biflorum*) to dandelion. Another was working on vetch, from which it flew to the flowers of a trumpet honeysuckle (Lonicera), thus visiting in succession flowers belonging to three different families and of three different colors.—*Clarence M. Weed, Mich. Agr. College.*

Examining the Heads of Insects, Spiders, &c., alive.—Mr. E. T. Draper recommends a cone of pasted paper to be made

rather larger than the specimen, with the apex cut off. A vigorous spider will soon project its head through the aperture; when in this position it should be blocked behind with cotton or wool slightly wetted. The cone can then be gummed to a slip, apex upwards.

Many insects can be arranged in the same way for the observation of facial movements, and such front views admit of interesting and extended study; the action of the antennæ, palpi and various organs of the mouth may be watched and curious effects produced by the excitation of saccharine or nitrogenous juices, administered from the tip of a sable pencil.—*Journ. of the Royal Micros. Soc., April, 1884.*

Anatomy and Function of the Bee's Tongue.—In a paper read before the Linnean Society of London, Mr. F. J. Briant remarked that authorities are yet divided in opinion as to how the organ in question acts. Kirby and Spence, Newport and Huxley aver that the bee laps its food; while Hermann Müller and others attribute a full share to the terminal whorl of hairs to which the honey adheres, and therefrom is withdrawn. Mr. Briant, on the other hand, from experiment and study of the structures, is inclined to the view that the honey is drawn into the mouth through the inside of the tongue by means of a complicated pumping action of the organ, aided by the closely contiguous parts.

We might add that Réaumur states that the bee does not suck up the liquid sweets but laps them up with its long slender hairy tongue. A better view than Mr. Briant's is, it seems to us, that of Shuckard, quoted in our "Guide to the Study of Insects."

Entomological Notes.—The number last issued of the Transactions of the American Entomological Society, the first of Vol. xi, is no less valuable than its predecessors. It contains Dr. S. W. Williston's tables, or rather synopses, of two groups of the North American Asilidæ, illustrated by two plates, with an account of a new genus of Syrphidæ. Our Asilids are but little known. There are three subfamilies, the Dasypogoninæ, comprising thirty-five genera and one hundred and twenty-five species; the Laphrinæ with eleven genera and fifty species, and the Asilinæ. The latter group is little known. W. Ehlers, of Spain, describes two new blind Bembidii, one from St. Thomas, West Indies, and the other from Florida. Mr. Frank Aaron describes and figures new species of Psocidæ from near Philadelphia, among them a brown variety of *Atropos divinitaria*, and a new form, *Atropos purpurea;* also a new genus, Dorypteryx (*D. pallida*). A useful synopsis, with a plate, of the North American Apioninæ, a subfamily of weevils, is published by Mr. John B. Smith. The Cucujdæ of America north of Mexico are revised by Lieut. Thos. S. Casey, U.S.A. The article is illustrated by four plates.——Among the other good articles in the *Canadian*

Entomologist for April is one on "the survival of the fittest" among certain species of Pterostichus as deduced from their habits, in which Mr. J. Hamilton gives some facts bearing on the extinction of species of these ground-beetles in the vicinity of large cities. Of the sixteen species mentioned four must soon become extinct, and six may possibly exist in the future as rarities, four will occur not uncommonly, while two (*stygicus* and *lucublandus*) will remain as now, common.——Under the caption "La feuille qui se transforme en insecte," M. Preudhomme de Borre figures the larva of a singular mimetic form of Orthoptera (*Chæradodis rhombicollis* Latr.) from Quito, which is popularly supposed to change into a leaf.——*Zeitschrift für wissenschaftliche Zoologie*, for June 27, contains a lengthy article, with numerous illustrations, on the adhesive apparatus on the tarsal joints of insects, by G. Simmermacher, to which we shall again refer.——Mr. Hulst's monograph of the genus Catocala is apparently completed in the third number of the Bulletin of the Brooklyn Entomological Society. It contains a brief synopsis of the species, filling four closely printed pages; then follows synonyms and descriptions of the species, the latter rather too brief, but yet comparative. While the paper hardly fulfills the requirements of a monograph it is an excellent synopsis.——In his "Contributions a l'histoire des metamorphoses des Longicorns de la famille des Prionidæ," M. Aug. Lameere describes and figures the pupa of *Parandra polita* Say.——A case of development of the imago in an ichneumoned pupa is recorded in the *Entomologists' Monthly Magazine* for July, by A. F. Griffith, who, in a pupa of Tæniocampa, found that "the moth had apparently died, as so often happens, when just ready for emergence, but within the body was a parasite alive, also just ready to emerge."

ZOÖLOGY.

Structure of the Otocysts of Worms.—M. E. Jourdan's investigations were made upon the small Arenicolæ of the coast of Marseilles and in the laboratory of that place.

By sectioning the cephalic segment of an Arenicola previously fixed by the injection of a solution of osmic acid of 0.50 per cent, the auditory capsules were shown in some sections and easily recognized by their little calcareous corpuscles. The otocysts are situated in the thickness of the integuments, far from the hypodermis and in the midst of muscular bundles; they are fixed by the connective envelope of these bundles, which surrounds them. They are not in direct contact with the œsophageal commissures, but connected with them by several nerves. They are placed towards the dorsal surface.

The nerve fibers composing the commissure and the brain are very fine and striated longitudinally. Nerve-cells exist throughout the length of the commissure, some in its interior, but a much

greater number between the commissure and the hypodermis, often intimately connecting these two parts.

The otocysts are spherical. The diameter of their cavity is $\frac{11}{100}$ millim., and that of the sphere formed by the outer capsule $\frac{22}{100}$ millim. The thick walls consist of a layer of fusiform cells, a network of fibrillæ arranged in a dense plexus, and a connective envelope. The cells form the greater part of its thickness; they are very delicate, spindle-shaped, slightly inflated towards the middle, where the nucleus is situated; they also increase in thickness towards their inner extremity, where they are surmounted by a thick plate. The plates of all the cells are closely soldered together, forming a cuticle, which, in sections, is often detached from the cells which produced it. No layer of vibratile cilia was to be seen distinctly, but indications of them seemed to exist upon portions which had been long in osmic acid. The cells taper at their base and at the same time bend in different directions; and these basal prolongations anastomose and form a very delicate network of fibrillæ, which, by their union, constitute at the base of the epithelial layer a regular little zone, intermediate between the nerve-fibers and the foot of the cells; a few nuclei are distinguishable in it. This plexus rests against the connective envelope, which is formed by a thin and dense membrane, presenting perforations through which the basilar plexus enters into relations with the nerve-fibers.—*Comptes Rendus, March 24, 1884, p. 757.*

On the Pelagic Fauna of the Swiss Lakes—Dr. O. E. Imhof gives a brief summary of the investigations hitherto made in the Swiss lakes, from which it appears that up to the present time there have been found more entomostraca than true pelagic animals. He then describes the results of his own researches upon several of the lakes. He has found nine new representatives of the pelagic fauna, of microscopic dimensions it is true, but, like the crustacea, represented by a great number of individuals.

Dr. Imhof characterizes the true pelagic forms by means of the following two principal remarks:

1. The animals which are truly pelagic from their birth to their death always swim freely in the water, never going either to the shore or to the bottom of the lake, and never touching the surface of the water, so as to avoid coming directly in contact with the atmospheric air.

2. The true pelagic animals carry their ova (with the exception of the winter egg) either attached to the exterior of the body or in a sort of incubatory cavity until the young individual, whether immediately like its mother or subject to transformation, can quit the envelope of the egg or the incubatory cavity, and lead at once the mode of existence of an accomplished swimmer.

The author has studied the pelagic fauna of the following lakes:

Zurich, Zug, des Quatre, Contous, Egeri, Katzen, Greifen, Maggiore, Lugano, Como and Garda.—*Bibl. Univ., Arch. des Sci., October 15, 1883, p. 349,* and *Journ. Roy. Micr. Soc., April, 1884.*

THE "MAN-EATER SHARK," *Carcharodon carcharias* (Fig. 1 and Plate XXXI).—The various descriptions given of this species are so very imperfect and confusing that it is safe to say, with Professor D. S. Jordan in a recent letter to me, "There is no good description of the animal extant. The earlier writers spoke of it without knowing it, and all had more or less confusion between it and *C. lamna.*"

This shark was taken by me on the fourth day of August, 1883, about two miles off Great Point lighthouse, Nantucket, Mass.

The experienced fishermen of Nantucket, with all their opportunities for investigating this interesting family of fishes, were ignorant of the correct name of this specimen, and they regarded it as a rare species in the waters of that vicinity. It therefore became to me an object of special interest and study.

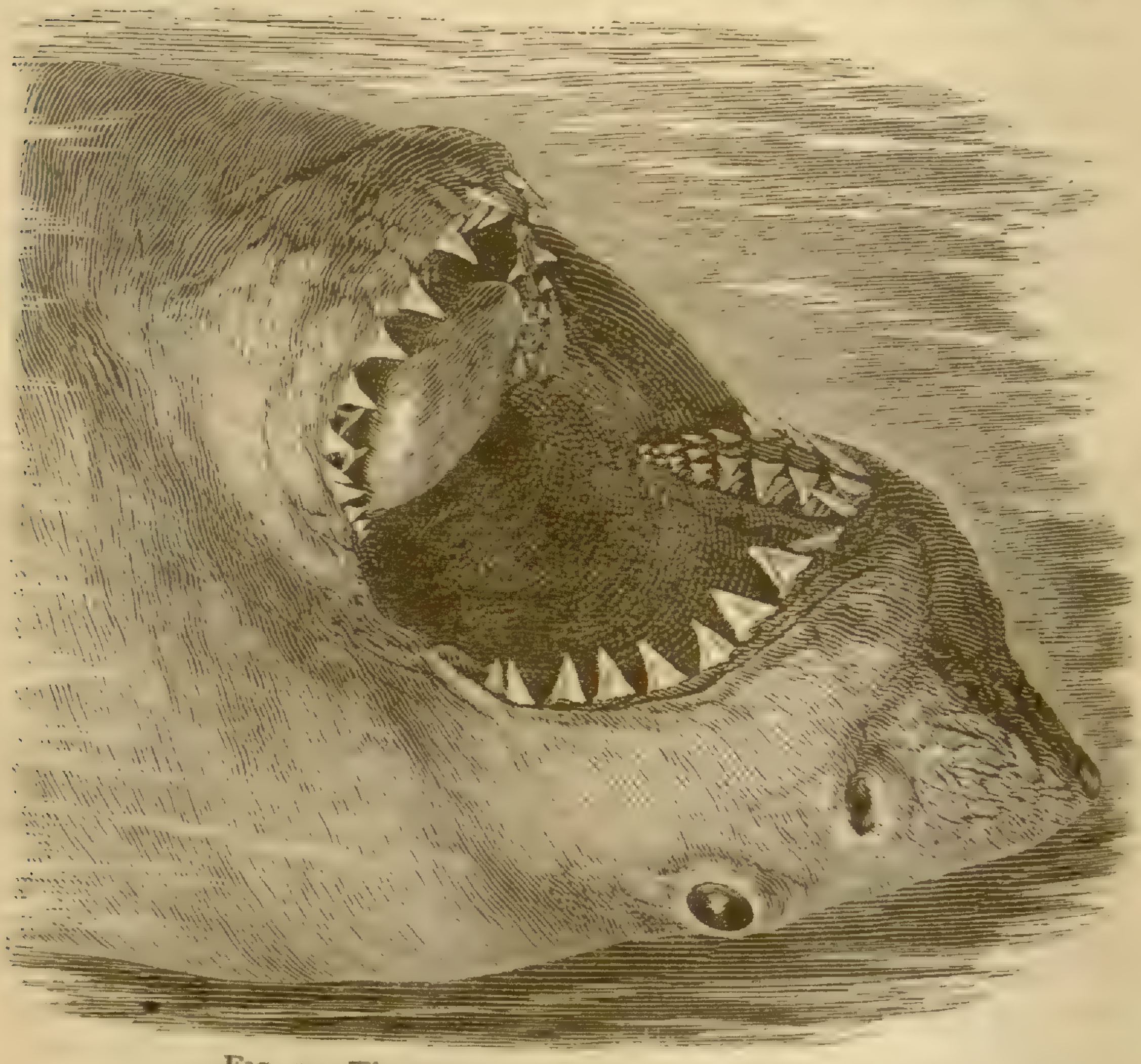

FIG. 1.—The Man-eater Shark; position of attack.

The specimen which gives me the data for this note, I have placed in the museum of Vassar Brothers' Institute in this city.[1]

[1] A full description appears in the Proceedings of the American Philosophical Society of July 18, 1884.

PLATE XXXI.

The Man-eater Shark. From a photograph.

The accompanying cuts are taken from photographs.—*W. D. Stevenson, M.D., Poughkeepsie, N. Y.*

Water-pores of the Lamellibranch Foot.—H. Griesbach has maintained the existence of *pori aquiferi* in the lamellibranch foot, while J. Carrière held the contrary view. J. T. Cattie has studied a considerable number of species, and does not find the least trace of aquiferous pores; and F. Barrois arrives at the same results. He discusses the work of Carrière and himself, and finds that they have studied most of the forms where the presence of aquiferous pores has been claimed, and in every case finds pores absent, or in such position that it seems they are either connected with the functional byssogenous organ, or, where such is absent in the adult, with the remnant of the same. Barrois sums up his views thus: "No pores exist for the introduction of water into the circulation; the only pores of the foot are those connected with the byssus organ, which never communicates with the interior of the foot. The blood may have water introduced into it, but this may be effected by osmosis, or in some manner not discussed."—*Journal Royal Microscopical Society, April.*

Two Species of Manatee in Brazil.—The mammals collected by Natterer, the Brazilian traveler and naturalist, are being worked out by A. von Pelzeln, two parts of his memoir having, according to a notice in *Nature*, appeared of the Sirenia. Natterer met with a manatee high up the stream of the Amazons, in the Rio Negro, Rio Brancho, and Madeira, and maintains in his notes that the species which inhabits these far inland waters is quite different from the *Manatus americanus* of the South American coast. Natterer called it *Manatus inunguis*, from its nailless fingers, and sent home to the Imperial Cabinet of Vienna three complete specimens and several skulls of the animal. Natterer also met with two species of dolphin in the Amazons and its tributaries.

Abnormal Food of Cats.—Strange as it may seem, little has been published upon the abnormal appetites acquired by many of our domestic animals. A moment's thought shows that all the cooked food and the milk which cats obtain in considerable quantity in a tamed state could never have formed any part of the food of their wild ancestors, while fresh fish, the food which few cats can resist the temptation of stealing, would be eaten but rarely by cats which were obliged to capture the fish for themselves, although I have seen a manx (or so-called tailless) cat bring home fishes, even eels, which she had the courage to capture in shallow pools of the tail-race of a saw-mill when the mill was stopped.

From the natural food of cats, the flesh of vertebrates, one might readily expect them to catch and eat insects. Adolph Müller mentions[1] that his cat regularly hunted at twilight the

[1] Zool. garten, Aug., 1880, jahrg. 21, pp. 253–54.

moths, chiefly Noctuidæ, in his garden. About 1870 I had a cat that, nearly every hot afternoon in summer and autumn, caught grasshoppers (Caloptenus and Oedipoda), and brought me her insect captures alive before eating them, with as much pride as if she had taken mice or birds. During the past summer I noticed several cats capture and eat beetles of the genera Lachnosterna and Prionus; the odor of the beetles of the latter genus seems sufficiently pungent and repulsive to drive away cats, since they dislike most pungent odors, but I have seen two cats that apparently regarded Prionus a delicacy, for they would eat dead, mutilated, sometimes half-decayed beetles of this genus, which they found about the yard.

Tempted by the butter or other kinds of fat upon mashed potatoes, or by the meat mixed with the potatoes in certain sorts of hash, the domestic cat has learned to eat potatoes, but most cats dislike them; cats have been in similar ways forced into accepting bread, but it still remains true that the majority of well-fed cats will reject bread unless buttered or soaked in milk. Still the cat likes a few peculiar flavors; their extreme passion for catnip (*Nepeta cataria*), and their fondness for valerian (Valeriana), have been long since observed and noted. Kleberg says[1] that the cat likes golden bread, *i. e.*, a bread flavored with saffron and spices; that it likes ginger-bread, rose-water rolls, and raisins. I have seen several cats that ate raisins, and one cat that would eat raisins, peanut-candy, lumps of sugar, figs, and nearly all kinds of nuts, but this cat was an especial pet and tasted of almost everything which its mistress ate, eating some of her food when the flavor did not prove too disagreeable.

Last summer I was greatly surprised, however, knowing the antipathy which cats generally have to amylaceous food, to find that my cat often would eat cooked green corn in preference to beefsteak. When especially anxious for corn he eats not only the corn from the cob, but the softer portions of the cob itself, although he likes best to have the corn cut from the cob for him. The idea naturally suggested itself at first that the butter on the corn led him to eat it, but he eats it greedily without butter, and often has made a hearty dinner of from one-half to a whole ear of corn, while meat remained on his plate untouched. Raw corn is not very acceptable to him, although sometimes eaten; for this farmers should be thankful, since if the feline appetite for raw corn was as good as it is for cooked corn the cats might attack cornfields, eat the corn from the ears, and thus become a serious foe to agriculture.

The belief that corn-eating was an individual peculiarity of my cat was soon dispelled by experiments with a number of other cats, all of which ate green corn with equal readiness. Further

[1] Zool. garten, July, 1878, jahrg. 19, pp. 211–213.

experiments showed that brown-bread, johnny-cake, and pastry made chiefly of Indian meal, are eaten readily by cats, and that oat-meal, in its different forms, is more agreeable to them than is food which consists mostly of wheat flour. This appetite for corn explained why I had seen, a number of years ago, two half-wild kittens stealing daily the uncooked meal mixed with water and given to chickens, and it shed light on the reason for the peculiar avidity with which some cats feed upon popcorn. I had previously attributed the appetite which cats have for popcorn to the preference that they exhibit for crisp food, for food that crackles while being chewed.

It would be entertaining and instructive if some one would take advantage of the cat-shows which are held now and then in our large cities, where a considerable number of pet cats are collected together, and write out a series of notes on the strange appetites acquired by the feline race from its intimacy with man. Statements should be based upon actual experiments made in each case by the writer, and not upon the assertions of the owners of the cats. The percentage of cats that would eat corn, raisins, candy, and other substances not ordinarily eaten by cats, could be determined readily in that way.—*George Dimmock, Cambridge, Mass., March 14, 1884.*

Zoological Notes.—*Infusorians.*—Dr. A. C. Stokes describes in the *American Journal of Science* for July, several new species of infusorians from fresh water taken from the sediment at the bottom of an aquarium. *Loxodes vorax* Stokes was observed to make a choice in its food. Of the new genus Apgaria, three new species are described; of the new genus Ileonema a new species, and of the new genus Solenotus, two species are described; all are figured.

Cœlenterata.—M. Bedot has investigated the nature of the organ usually called a liver, situated between the two lamellæ that form the pneumatocyst of Velella. The principal part of the organ consists of a mass of cnidoblasts. Above this mass of cnidoblasts is a layer of small tubes closely packed together, and containing cellules, some of which are black or dark green. The less closely placed canals below the mass of cnidoblasts have but few dark grains. M. Bedot believes that this organ is that which forms the cnidoblasts, and he finds in the lower lamella of the floor of the pneumatocyst numerous openings, by which the stinging cells find their way into the ectoderm. If any part of the organ subserves the purpose of a liver, it can only be the superior portion in which the dark cellules occur.——W. K. Brooks (loc. cit.) contributes some notes upon the larval forms of *Turritopsis nutricula, Cunina octonaria, Nemopsis bachei, Phortis gibbosa*, and *Amphinema apicatum*, as observed at Beaufort, N. C. The first of these remains attached to the stem for some time after

the rupture of the perisarc, and has, when set free, eight tentacles, a thin globular bell, and a simple proboscis. In examples two weeks old, the stomach is suspended some distance below the sub-umbrella by a transparent mass of large cells, and the lower surface of the wide velum is pushed out to form eight hemispherical pouches, four perradial and four interradial. *C. octonaria*, as stated by McCrady, lives in its young state as a parasite within the bell of Turritopsis. The medusa of *N. bachei* L. Ag., is derived from a fixed hydroid closely related to Bougainvillea and Eudendrium. In the simplest stage of the medusa there are four tentacles, but others bud from the same points, forming clusters. In *P. gibbosa* the medusæ escape, one at at a time, from a gonotheca containing three or four. The apical process in Amphinema is not present in the larval medusa, but commences to develop on the third day.

Worms. — A recently issued part of Semper's "Reisen im Archipel der Philippinin" contains an account of the Sipunculids by Drs. De Man, Bulow and Selenka. Seven colored plates accompany the text.——A magnificent atlas of the Rhabdocœlida, containing twenty highly finished and colored folio plates, has been issued by Dr. L. von Graff, to accompany his extensive monograph of the Turbellaria, the first part of which contains descriptions of 259 species of Rhabdocœlida.——The otocysts of *Arenicola grubii*, according to M. Et. Jourdain, are situated on the dorsal aspect in the midst of muscular fibers, and are fixed by their conjunctive envelope, which is prolonged over them and surrounds them. They are not in immediate contact with the œsophagean commissures, but are simply united to them by several nerves.

Mollusks.—Sowerby's "Thesaurus conchyliorum" has reached its forty-second part. The last issue contains monographs of Teredo and Kupheo, Gastrochæna, Fistulana, Saxicava, the Pteropoda, and numerous other genera, including Tridacna and Hippopus, the varieties of which are very fully figured.——Henri Drouet (Bailliere, Paris), has put forth a monograph of the Unionidæ of Italy, which comprise forty-three forms of Unio, six of Microcondylus, and thirty-one of Anodonta. The basin of the Po and Upper Italy is one of the richest districts in Europe with respect to this family.

Arachnids.—At a recent meeting of the Academie Royale des Sciences of Belgium, M. MacLeod gave a preliminary communication upon the anatomy of Trombidium, Argas, Hydrachna and Gamasus. The suckers of the two first genera differ considerably; it has been proved that a communication exists in Trombidium between the stomach and the terminal intestine; a powerful muscle has been found to be attached to the supposed poison glands in that genus, and the course of the excretory canals of the salivary glands has been followed. Certain granules contained in the terminal intestine of Argas are formed in special

tubes which present much analogy to the Malpighian canals of the Araneidæ described by Plateau.

Crustaceans.—E. A. Birge (Stud. from the Biol. Lab. J. Hopk. Univ., 1883), describes and figures various stages in the development of *Panopæus sayi*. The zoea moults a large number of times. In the change to the megalops stage all trace of the long spines is lost. In this it differs from Cancer, in which the megalops retains the dorsal and frontal spines. The last megalops stage is reached after at least four moultings.

Birds.—The osteology of the kingfisher (*Ceryle alcyon*) is described and well figured by Dr. Shufeldt in the *Journal of Anatomy and Physiology*, XVIII, 279. After touching upon the general characteristics of kingfishers, their distribution, mode of life, and the views of the leading authorities upon their taxonomy, he then examines the skeletons. The account is rendered a comparative one, as Alcedo is compared with Ceryle, and sometimes with Geococcyx and Coccyzus.

Mammals.—M. A. Milne-Edwards announces the discovery of a new species of Hydropotes, called by M. Hende *H. argyropus*. It is a native of Corea, and differs from *H. inermis* in the lighter color of its hair, and in some cranial characters.

PHYSIOLOGY.[1]

Biological Action of the Salts contained in Sea Water on the existence of Marine Animals.—An essay on this subject by H. A. Coutance, has been translated and published in the last report of the U. S. Commissioner of Fish and Fisheries. Marine animals are organisms of excessive sensibility, and in their distribution are dependent on the composition of the salt water, the nature and quantity of the gases dissolved, and the temperature, force and operation of the currents. M. Coutance experimented on the common mussel, the *Venus decussata*, the common periwinkle, and the whelk, *Buccinum undatum*.

By reason of their different organization these mollusks gave very different results. The bivalves which could shut themselves up between their valves, as a general rule, showed greater resistance than the univalves. Of these the periwinkle, whose operculum can close entirely, prudently retired into the remotest coils of the spiral, and were thus better protected than the buccins, whose opening does not shut tightly, and into which the water can easily enter by the canal at the mouth of the shell.

Salts of potash seem much less favorable than the salts of magnesia, and especially than salts of soda. Life ceased first in the ioduret, the bromide, the chloride, and the sulphate of potassium, and in solution No. 10, the prevailing element of which is chloride of potassium.

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

The salts of soda and magnesia still maintained life when the animals had succumbed in the salts of potash. Solution No. 9, for instance, the principal element of which is chloride of magnesium, preserved its inhabitants alive much longer, and the same applies to the sulphate of magnesia alone, and in solution No. 11.

The resistance of the palourdes in the Vichy water shows the favorable action of salts of soda on the preservation of life in marine animals; for forty days the palourdes lived in this mineral water!

It was in the sulphate of magnesia and the sulphate of soda that life was sustained longest, the latter excelling the former. On the 12th of March I tasted some of the *Venus decussata*, which had been kept in sulphate of soda for sixty days, and found their flavor excellent and without any trace of a bitter flavor. This observation might prove useful in alimentary economy, as the palourde is a highly prized shellfish, and sulphate of soda can be bought cheap.

It is a fact worthy of remark that it was only in the solutions of sulphate of soda and sulphate of magnesia that green algæ commenced to make their appearance at the end of sixty days. The conditions favorable to marine animal life are then apt to develop vegetable life. There is nothing surprising in this parallelism, but it receives from the present circumstance a curious confirmation. One singularity appears: the solution of chloride of sodium (impure marine salt) did not sustain life as long as the solutions of salt of magnesia and sulphate of soda, and yet salt is an essential element of the sea water. This proves that the mollusks are adapted, not to pure salt, but to that peculiar mixture which constitutes the natural sea water; and that the secondary elements, as regards their quantity, play an important part. This gives us reason to suppose that the accidental modifications of the water of the sea during the different geological periods must have had a great deal to do with the extinction of various species.

The Venus remained closed in most of the solutions, the nature of which they doubtless learned to know by opening their valves a very little. Meanwhile, they occasionally put their siphons outside the shell, for instance, in the sulphate of magnesia and in the sulphate of soda. In the solution of chloride of sodium and in the sea water they had their siphons out nearly all the time.

The palourdes can live for more than a month in the air in a cool place. For about twenty days they remain shut; later they open their valves and protrude their siphons. At the least touch they draw them in and close their valves. Then comes the moment when the striped muscles which bring the valves together have no longer the strength to do this, although the smooth muscles which retain them will still do so, when one closes the valves. In all the solutions in which these mollusks have lived these same phenomena could be observed.

The weakening of the muscles showed itself first in the striped part of the adductors, which draw the valves together, and later in the smooth part of the same muscles, which held the valves artificially closed for a constantly decreasing period.

The *Venus reticulata*, or clovisses, showed the same phenomena; the order of extinction of vitality in the different solutions was the same; but these mollusks did not live as long as the preceding ones. They succumbed a month after they had been placed in the solutions, first in the salts of potash, then in the salts of magnesia, and finally in the salts of soda.

The periwinkles resisted longer than the bivalves, and showed less repugnance to the sulphate of soda, in which they lived forty days.

The great buccin succumbs much quicker, as it cannot close its shell hermetically like the periwinkles. At the end of twenty-four days it died in most of the solutions employed, especially in the salts of potash. Its life was prolonged forty-eight hours in solution No. 12, in the sulphate of magnesia, and in the sulphate of soda, but soon came to an end.

During all the time these experiments were going on, from January 10 to March 15, the palourdes and the periwinkles lived in the sea water of the laboratory, the *Venus reticulata* and the mussels not quite so long, and the buccins only a few days.

It is a very important fact, to which we direct special attention, that the salts which constitute the sea water and the different solutions which we employed gave to the water the faculty of dissolving variable quantities of atmospheric air. We proved by direct experiments that the solutions of salts of soda retain more air when agitated by it than the solutions of salts of potash. This would, therefore, prove that the poisonous character of the salts mentioned in our experiments is caused in part by the circumstance that they do not let their solutions become sufficiently aërated; their action produced asphyxia. This explains why the sulphate of potash and the sulphate of soda, neutral salts to which the mollusks are by no means adapted, act so differently upon them, the salts of potash killing them quickly and the salts of soda preserving them for some time.

From these experiments the following conclusions have been reached:

1. The saline elements of the sea water act very differently on mollusks.

2. Every modification in the composition of the sea water finally becomes fatal to the life of these animals.

3. Their greater or less resistance depends on their organization. Bivalves resist better than spiral shells, and in these two groups the results vary according to the different species.

4. Salts of potash are less favorable to the life of mollusks than

salts of magnesia, and salts of magnesia are less favorable than salts of soda.

5. Outside of the salts dissolved in sea water the sulphate of soda seems to possess a well-established preserving neutrality.

6. The death of bivalves is caused by a general weakening of the muscles.

7. As the muscles can no longer draw together or open the valves, the animal is exposed to the unfavorable or poisonous action of the element.

A New Explanation of the Process of Inflammation.—In the last number of the *Quarterly Journal of Microscopical Science* there is a translation of Dr. Elias Metschnikoff's paper "On the Mesodermic Phagocytes of certain Vertebrates," originally published in the *Biologischer Centralblatt.* Metschnikoff has shown elsewhere that certain amœboid cells in the tissues of the invertebrates have the power of ingesting and absorbing food particles. On experimenting with vertebrates, he found that the connective tissue cells had the same power, and that, in a batrachian larva about to metamorphose, the absorption of the tail was brought about by these cells, which he terms "phagocytes." At the beginning of the metamorphosis these amœboid connective-tissue cells collect round the muscles of the tail, and gradually devour their fibers. The fragments of muscle retain their structure for some time after ingestion, so that that process can be readily seen to take place, but gradually lose their striation and break up into rounded strongly refracting globules. In order to ascertain whether these "phagocytes" would absorb, and so eliminate from the system injurious substances, Metschnikoff injected putrescent blood, so as to induce septicæmia. In a short time the white blood corpuscles (which are also included in the term "phagocytes"), were seen to contain both still and motile bacteria, and these organisms were especially abundant in the "hæmophagocytes" or white blood corpuscles of the spleen. This fact, taken together with the probability that the spleen has no very important physiological function, since animals live without much apparent discomfort after its complete excision, seems to indicate a prophylactic function for the spleen, it being merely a protection against septic bodies such as bacteria, the removal of which from the body is its function.

To apply these facts to the process of inflammation. When inflammation was induced in the tail of a newt, the first phenomenon was the collection of connective-tissue "phagocytes" round the injured cells, followed by the passage of "hæmophagocytes" or white blood corpuscles through the walls of neighboring capillaries, both collecting apparently for the purpose of devouring and so removing the ruptured, dead and dying cells.

In fact the essence of the whole inflammatory process may be

said to be a conflict between the "phagocytes" and the septic material, whether the latter be a dead or dying cell, bacteria or other foreign body. In the invertebrates, where connective-tissue cells are abundant, the vascular system does not participate in the process, only doing so among vertebrates, where the extra-vascular "phagocytes" are not sufficiently numerous to combat the injurious structures, a call for assistance being then given to the "hæmophagocytes." The first effect of irritation is on the connective-tissue "phagocytes," the changes produced in them subsequently influencing the capillary walls, and allowing the transit of the white corpuscles.

The theory has much to recommend it, being founded on logical, *á priori* grounds, and affording simple explanations for many obscure points in connection with inflammation. For instance, it affords a simple explanation for the presence of the large numbers of connective-tissue and white blood corpuscles that have been observed in induced keratitis, and also it explains how in certain epidemic fevers—famine-fever for instance—numerous sprilla, etc., can exist in the blood of as yet unaffected individuals, without causing any symptoms of the epidemic. At the same time the theory is quite compatible with all definitely ascertained pathological facts, a circumstance which alone would give it considerable weight.—*Professor McMurrich, in Canada Lancet, May, 1884.*

PSYCHOLOGY.

Singular Friendship between two Birds.—During the summer of 1880, I purchased from a Chicago bird dealer a number of birds for my aviary, and in making my selections, the dealer, after considerable parley, permitted me to separate a male "African cutthroat finch" from his mate, which, with the others, some thirty birds, were shipped here. Of the number was a male white Java sparrow, whose principal occupation seemed to be the pecking and pulling out of feathers of the cutthroat finch. The separation of these two birds was the only way to have peace in the cage, but upon their being brought together the old feud was resumed. While in the cage with the rest of the birds there was but one that took any part in the conflict or attempted to shield the cutthroat, and this was an indigo finch (*P. cyanea*).

The moment that the two were placed in the one cage the Java would at once fly upon the frightened finch and nearly kill him, and he would rush from one side of the cage to the other, eagerly trying to find some place of retreat; perhaps behind some other bird, but only for the moment, for the vicious Java would drive him from his shelter to again chase him to his heart's content.

In the meantime I ordered more birds, a mate for the Java and a number of finches from Africa and other countries, and upon their arrival the experiment of watching their reception by the

birds of the avairy was at once proceeded with. The heretofore abused cutthroat was also placed in with the rest.

Immediately upon his entrance his former manner was changed, and so suddenly, as if by magic. His former expression denoting fear was now abandoned, and the little fellow, with all the sprightliness of the monarch of the aviary, a flit of his wings, a chirp, and he was by the side of a small finch I had not as yet identified. The new-comer was crouched upon the floor of the cage, in fear, and partly perhaps through exhaustion.

It was at once evident that these birds were friends, for there was a caressing of bills, a few notes from the bird, which proved to be a female cutthroat finch, and an apparent communication between them, yet with all their apparent pleasure there was something that made the male cutthroat utter a savage cry, almost a shriek, and away he darted from the side of his restored mate and straightway he attacked the newly arrived Java sparrow. From side to side of the cage they flew, he in hot pursuit; at last he mounted upon her back and with fearful strokes pulled away at her feathers, on the side of her head and neck. The Java uttered tones of pain, but the cutthroat was upon the war-path, avenging the wrong done his former companion. The other birds flew wildly to the top and sides of the cage, seeking shelter from the savage little finch, so suddenly become a monarch. A day before and but one friend did this little outcast have in all the inhabitants of this large cage, and this one the lonely indigo finch. At last the male Java sparrow, the tyrant, went to the rescue of the newcomer of like species; but what a change came over the ruler of that cage, when the cutthroat, with a wild harsh cry, flew upon his assailant and catching him by the lores pulled away like a bull-dog. Another change of position and the finch was upon the sparrow's back, and away they both went, to all parts of the cage, the little one keeping his hold, while each of the other occupants excepting the female cutthroat and indigo finch sought refuge by clinging to the top and sides of the cage, as far as possible from the scene of action. Even a Baltimore oriole that had many times taken pleasure in pecking his sharp bill at the helpless cutthroat, now sought refuge, and even more eagerly than the smaller birds. At last the female cutthroat chirped more loudly than before, and though in the heat of the battle the little mate left his abuse of the sparrow and flew to her side.

At this procedure there was some hurried chirping and instantly the male hopped over to the opposite side of his crouched mate. Then with his bill he laid aside the feathers of her wing, pushing his bill well up into her feathers, thence hurriedly withdrawing, another cry, and once more, more viciously than ever, he flew at the female sparrow, starting her in wild flight before him; in his way he passed the male; at once turning he lit upon him as if to chew him up. Thus did the battle continue for some time until the sparrows were exhausted.

And strange to say that while this last scene was being enacted in the aviary, the indigo finch went to the side of the wounded bird as if to be of greater security, which was needed during the bird's indisposition.

Such was the change in this motley flock of birds, that all but the indigo finch and the female cutthroat feared her mate.

For fear of accident I removed the two finches, male and female, to a cage by themselves, where they remained for some days, when at last the female died from injuries sustained, as I believe, through the attacks of the female Java sparrow while the birds were en-route from Chicago here.

After her death, I again placed the disconsolate mate back into the large cage where, for many weeks, no song was heard from him, and at anytime one could witness the two friends, the indigo and cutthroat finches, sitting as closely as possible to each other upon the perch, and as far as possible from the other birds.

And again, many times did I permit the door of their cage to be left open that all the birds might fly about in a large room if they so wished, and in every instance one of these friends did not leave the cage without the other one following, and when tired of flying about they would nestle together, side by side, upon some picture frame and there in mutual sympathy commune by thought as one.

Truly these were friends and their sympathies went out to console one another. There was no more fighting in this cage and though a long time passed before a song was heard from the affected mate, when it did come it was but a feeble melancholy ditty.

Several of the birds in this cage were kept together for nearly two years, of the number, the four above referred to, and in all that time there was no more fighting nor was there any lack of friendship between the two bird friends referred to here.

At last, when I found I could no longer care for my birds as I ought to, they were forwarded to St. Louis, Mo., and though some died upon the way, I believe the most of them are at this day in the Zoölogical Gardens of that city.—*D. H. Talbot, Sioux City, Iowa.*

Filial Affection in a Horse.—M. Briot, chief engineer of the province of Scutari, Turkey, sends the following to the *Révue Scientifique*. A band of Albanian mountaineers, with their flocks, cattle and horses, arrived at the Drin when that river was swollen by a freshet. To cross in the only boat at hand would have taken twenty-four hours at least, so they tried to force the animals to swim. About twenty horses, including five or six mares with their foals, were at length driven into the water. All crossed safely except one old mare laden with an enormous burden. Gradually forced downwards by the current, she seemed to give up the struggle. But while the other foals were prancing joyously around

their mothers on the opposite bank, one ran around neighing sorrowfully. Soon this foal of three months came to the bank, and, gazing over the stream, perceived his mother, who was already carried some thousand feet down stream. With a piercing, indescribable cry, and a prodigious bound, he sprang into the water. For an instant he disappeared, then came into sight swimming vigorously towards his parent. Unable to see her for the waves, the young creature, who just before had feared to enter the water, sprang forward by bounds with outstretched neck, neighing at each bound. The mother heard and responded, raised her head and seemed again to care for life. The foal reached its mother, allowed her head to rest on his shoulder as he swam towards shore, and succeeded in saving her. "The horses here have more moral sense than the people," says M. Briot. He who reads the daily papers will be likely to come to the same conclusion as regards other countries than Albania.

ANTHROPOLOGY.[1]

BUREAU OF ETHNOLOGY.—The second annual report of the Bureau of Ethnology to the secretary of the Smithsonian Institution, 1880–'81, by J. W. Powell, director, is just issuing from the Government press, bearing the date 1883. The volume will be uniform in appearance with the first, and will contain XXXVII—about 500 pages, 77 plates, 714 figures and 2 maps. The following is the table of contents :

Report of the director. pp. XV-XXXVII.
Zuñi fetiches. By F. H. Cushing. pp. 9-46.
Myths of the Iroquois. By Erminnie A. Smith. pp. 47-116.
Animal carvings from the mounds of the Mississippi valley. By H. W. Henshaw. pp. 117-166.
Navajo silversmiths. By Dr. Washington Matthews. pp. 167-178.
Art in shell of the ancient Americans. By W. H. Holmes. pp. 179-306.
Catalogue of collections, etc. By James Stevenson. pp. 307-422.
Catalogue of collections. By James Stevenson. pp. 425-466.

The editorial work on the volume has been in charge of Mr. James C. Pilling, and the reader will feel his obligation to him on every page.

The report of the director is devoted mainly to an account of the operations of the bureau and to abstracts of the papers in the appendix. "The investigations," says Major Powell, "have been pursued in the four great departments of objective human activities, viz., arts, institutions, languages and opinions. The facts in each field of research throw such light upon each other field that one cannot be neglected without injury to the others." The work of the bureau is carried on mainly by specialists in its employ, but collaborators in all parts of the country assist in many ways.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

In addition to the monographs published in the annual report, works of larger range are in preparation for the series of contributions by Dorsey, Gatschet, Riggs, Pilling, Smith and Mason. Field work is reported by Henshaw, Hinman, MacCauley, Smith, Cushing and Stevenson. The following brief abstracts will give some notion of the papers above mentioned:

Since 1879 Mr. Cushing has been a member of the Zuñi tribe of Indians. No other individual in our time has enjoyed greater advantages of becoming familiar with the inner life of savagery.

The Zuñis suppose the sun, moon and stars, the sky, earth and sea, plants, animals and men to belong to one great system of all conscious and interrelated life, in which the degrees of relationship seem to be determined largely, if not wholly, by the degrees of intimacy. It naturally follows that worship relates especially to animals, more nearly related to man than are the remote powers of nature, yet more nearly related to these powers than to himself. Zuñi fetichism seems to have arisen from these relationships. The use of fetiches is chiefly connected with the chase, and the six prey gods are the mountain lion, the bear, the badger, the wolf, the eagle and the mole, answering to the four points of the compass, the upper and the under world. The Zuñi Iliad preserves in archaic phraseology the body of this mythology. It is impossible here to repeat any of the charming myths, which must be read in full to be enjoyed at all. We call the attention of archæologists to the constant presence of the arrow point in the wrappings of the gods and also to what is said about gashes in arrow-shafts on page 10.

Mrs. Smith pursues the same line of study as Mr. Cushing, and having spent much time in the tribes of the Iroquois stock, has been able to collect many new myths. The remarks of the author with reference to a belief in the "Great Spirit" and to the Hiawatha myth are of great importance. Hinu, the beneficent thunder god, holds a conspicuous place in the Iroquois pantheon. Next to him stand the West Wind, the North Wind, Echo and the Great Heads. Atotarho and Hiawatha are classed as demigods. The stories of the stone giants are full of interest, as are also those relating to the pigmies. In the chapter on sorcery the author enumerates the varieties of incantation. Chapter IV relates to the origin of phenomena, to which study Major Powell has given the name of savage philosophy; and chapter V is a collection of stories. Chapter VI closes this most interesting production with a brief discussion of religion.

Mr. Henshaw, an accomplished zoölogist, examines carefully the products of handicraft belonging to the Mound-builders, in order if possible to identify the species. The following are his conclusions:

"That of the carvings from the mounds which can be identified there are no representations of birds or animals not indigenous to the Mississippi valley.

"That a large majority of the carvings possess only the most general resemblance to the birds and animals of the region they were doubtless intended to represent.

"That there is no reason for believing that the masks and sculptures of human faces are more correct likenesses than are the animal carvings.

"That the state of art-culture reached by the Mound-builders, as illustrated by their carvings, has been greatly overestimated."

Just as, at a hurdle race, the crowds gather at the wickets to see the horses make the leaps, so the archæologists will be anxious to know how Mr. Henshaw gets over some of our archæological hedges and ditches. Well, the first animal to block the way is the manatee, and all will agree that the leap is effective. The next myth attacked is that relating to the toucan, and what is left of it "is easy of identification. The bird is a common crow or a raven, and is one of the most happily executed of the avian sculptures." The paroquet is treated more kindly, this species having abounded in the Mississippi valley; but the particular paroquet of Squier and Davis is made to step aside. Passing over the remarks upon various well-known forms and the skill shown in the carving, we come to Mr. Henshaw's attack on the elephant mound, concerning which he doubts whether an effigy without ears, tail, tusks or extended trunk can stand for a mastodon. The author throws discredit on the authenticity of the elephant pipes.

This is a very important contribution to archæology. The author depreciates too much the skill of the Mound-builders, but his work is exceedingly timely and will cause a thorough review of Squier and Davis's work.

Dr. Matthews is already well known to anthropologists through his linguistic studies, and in the paper before us gives a charming sketch of the processes, implements, and productions of the silversmiths among the Navajos. Nothing in all the volume will be read with more pleasure by those who realize that the adoption of new methods among savages, like the unfolding of the embryo, discloses the very life history of civilization.

Mr. Holmes's monograph is a masterpiece. Commencing with the simplest uses of shells among the aborigines for vessels, spoons, celts, cutlery and scraping implements, weapons, agricultural tools; proceeding to consider their employment in ornament as pins, beads, pendants and wampum; he at last brings us to his chapters on the gorgets, where he displays his utmost skill as an artist. The chapter on gorgets is an enlargement of the paper on the same subject printed in the transactions of the Anthropological Society of Washington, Vol. II. The forms discussed and illustrated are the cross, the scalloped disk, the bird, the spider, the serpent, the human face, the human figure. It seems almost aggravating that in the same volume wherein Mr. Henshaw

and effectually disproves the Mexican origin of many animal forms in the mound-pipes, new forms should be described, concerning which the author says that they "must be the offspring of the same beliefs and customs and the same culture of the arts of Mexico."

The last two papers are by Col. James Stevenson. In them are minutely described and profusely illustrated his four thousand specimens of stone implements, clay vessels, and objects made from vegetal substances, collected in Zuñi, Wolpi, Laguna, Acoma, Cochiti, Santo Domingo, Tesuke, Santa Clara, San Juan, Cañon de Chelly, Cuyamunque, Nambé, Pojuaque, Jémez, Silla, Santa Ana, Sandia, San Ildefonso, and from Taos. An excellent map, locating the Pueblos, both ancient and modern, accompanies the paper.

To the archæologist this collection will have great value, but it will still more impress the student of the unfolding of culture. The curious blending of old ideas with new ones is everywhere manifested, and the enormous amount of material will furnish data for sound comparisons.

Anthropologists will thank Major Powell very heartily for this volume and wish that the one for 1881–'82 will not be long delayed.

ARCHÆOLOGICAL CIRCULAR.—Dr. Charles Rau has just published in the Proceedings of the National Museum for 1883, an appendix relative to contributions of aboriginal antiquities to the United States National Museum. This publication is very timely, for, notwithstanding the growing avarice for relics, the Smithsonian Institution has a warm place in the affections of many people, and constantly receives donations of aboriginal antiquities. Those who collect relics to sell care nothing about the environments, so that their specimens are comparatively worthless. On the other hand, those who donate their treasures to a public institution wish to invest them with all the value possible. Now it is to just such patrons of science that Dr. Rau has addressed his circular, advising them how to proceed in every case.

THE AMERICAN ANTIQUARIAN.—The third number of Vol. VI of this standard periodical contains the following papers:

The Bridges of Ancient Rome. By F. C. Roberts.
Ancient Mexican and Cent. American Codices and Inscriptions. By Cyrus Thomas.
Lectures on Polytheism, II. By F. G. Fleay.
Translations of the Obelisk in New York. By A. C. Merriam.
Sioux Folk-lore and Mythology. By J. Owen Dorsey.
Emblematic Mounds. By S. D. Peet.

As usual, the correspondence and notes are of great value.

The editorial article of the present number is upon relic-hunting *versus* archæological survey. The NATURALIST has always strenuously held that the most rigid scrutiny by accomplished observers should accompany every archæological investigation. Without any knowledge of the merits of the present case, the

writer of this note earnestly implores all concerned to examine cautiously their ground before hurrying onward. Perhaps Mr. Peet is a little too fond of the old explorers and a little to hard on Mr. Thomas and Mr. Carr. However that may be, it can do no harm to put the gentlemen on their guard.

PEABODY MUSEUM.—The 16th and 17th annual reports of the trustees of the Peabody Museum, forming Nos. 3 and 4, of Vol. III, contains the following anthropological papers:

Report of the Curator.
List of Additions to the Museum and Library.
Social and Political Position of Women among the Huron Iroquois Tribes. By Lucien Carr, Assistant Curator.
Human Remains from Caves in Coahuila, Mex. By C. A. Studley.
The White Buffalo Festival of the Uncpapas. By Alice C. Fletcher.
The Elk Mystery of the Ogallala. By Alice C. Fletcher.
Ceremony of the Four Winds by the Santee Sioux. By Alice C. Fletcher.
The Shadow or Ghost Lodge; an Ogallala Ceremony. By Alice C. Fletcher.
The Pipe Dance of the Omahas. By Alice C. Fletcher.
XVIIth Report of the Curator, with lists of additions.
Report on Meteoric Iron from Mounds, etc. By L. P. Kinnicutt, Ph.D.

The report of the curator is one of his best, dwelling with special fullness on his explorations in the mounds at Madisonville, Ohio. With reference to the large mounds near cemeteries the author is led to suspect that they are simple monuments marking burial sites. The spool-shaped copper ornaments found in collections are identified as earrings. But the most notable revelation is that with reference to the discovery of wrought meteoric iron. This may lead to the revision of some late discoveries.

Mr. Carr, having examined the literature of the subject, comes to the conclusion that "the Indian woman was not the overworked drudge she is usually represented to have been."

The most fascinating part of the report is that containing the papers of Miss Fletcher. A young woman of rare intelligence, filled with benevolence, and thristing for knowledge, lives for two years in the wigwams of the Omahas and Sioux for the double purpose of doing them good and of learning their social condition. We have no doubt she was successful in the former, we are certain of her complete success in the latter. Indeed, some of the rites mentioned in Miss Fletcher's papers are for the first time described and illustrated.

The long lists of donations and accessions to the collection show how complete has been the success of the Peabody Museum.

MICROSCOPY AND HISTOLOGY.[1]

MOUNTING AND PHOTOGRAPHING SECTIONS OF CENTRAL NERVOUS SYSTEM OF REPTILES AND BATRACHIANS.—Dr. J. J. Mason describes the methods he employed in mounting the sections from which the plates illustrating his book[2] were "artotyped."

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.
[2] Minute Structure of the Central Nervous System of certain Reptiles and Batrachians of America, 1879, 1882. cf. III, p. 910.

Both the brain and spinal cord were entirely separated from the body, and, with their membranes, placed in iodine-tinted alcohol until they had acquired a slight degree of consistency—from six to twelve hours. They were then transferred to a 3: 100 solution of bichromate of potash, with a small piece of camphor, in a tightly-corked wide-mouthed bottle, and allowed to remain until ready for cutting, renewing the solution every two weeks.

The time required for the hardening process varies considerably in different animals, and this variation is more dependent upon the class of animal, than upon the relative dimensions of the specimens.

For example, on the same day I placed the brain of a large rattlesnake with that of a small salamander in the same bottle, and at the end of six weeks the former was ready for section, whilst the latter was not sufficiently hard until a month afterwards. By thus employing the same reagent in all cases, I have been able to note constant differences in the action of both the hardening and the coloring agent, carmine.

Perhaps the most striking illustration of this is furnished by the nervous centers of tailed batrachians, which, while they stain very readily, invariably require about a third more time to harden than specimens from the other orders. Specimens from ophidians stain less satisfactorily than those from any other of the classes which I have studied, while with the spinal cords of alligators, turtles, and frogs, failure to obtain good results in this particular is very rare.

In all cases the sections have been stained after cutting, injury from excessive handling being wholly avoided by the use of siphon tubes to remove the alcohol and washings. For producing transparency, oil of cloves has been used, and the mounting has been done under thin, clear covers, in a solution of Canada balsam in chloroform.

All the negatives have been made on glass thoroughly cleaned and lightly coated with a solution of wax and benzole, so that the collodion film, previously made adherent to thin sheets of gelatine, could be safely removed from the plate. The flexible negatives thus obtained are well adapted to the artotype process, and, as they can be indefinitely preserved between the leaves of an ordinary scrap-book, are very desirable for a series of illustrations. In making the original negatives on glass, the 'wet collodion process,' with the sulphate of iron developer, has been exclusively employed.

The prints correspond exactly with the negatives, both in outline and detail. No distinction occurs as in silver printing in which process the paper is subjected to prolonged washing.

In many of the photographs the gray substance appears lighter in shade than the white substance. This appearance is due to a greater degree of transparency of the gray substance in these sec-

tions, resulting from the action of the oil of cloves, followed by an increased action of the transmitted light on the sensitive collodion film of the negative, and hence by a thinner deposit of ink over corresponding parts of the positive plates from which the artotypes are printed.

With regard to the process employed, Dr. Mason says that after experimenting with various methods he found that satisfactory prints could be made in ink directly upon plate-paper, and that these impressions were as perfect in fine detail as any of those obtained by the silver process of printing. The plates (all printed by the artotype process), are as durable as steel-engravings. While a photograph cannot often show all that can be discovered by more direct microscopic observation with a judicious working of the fine adjustment, high authority has stated, and perhaps correctly, that a good photograph with a low power, say from three to one-half inch, is a better means of illustrating the anatomical structure of the nervous tissues than hand-drawing. Some of the plates with high powers leave much to be desired both in distinctness and tone, and in general it may be affirmed that the same defect as regards distinctness always exists, and for obvious reasons, in photographs of sections with powers much above one-half inch.—*Jour. Roy. Mic. Soc.*, IV, *part I, pp. 149, 150.*

A Starch Injection Mass.[1]—A coarse injection mass which is cold-flowing, may be forced nearly to the capillaries, rapidly hardens after injection, leaves the vessels flexible, does not dull dissecting instruments, is suitable for permanent dry or alcoholic preparations, is simple in its manipulation, cleanly and economical, seems to be fully realized in the starch mass introduced by Ad. Pansch, of Kiel, and since recommended, with various modifications, by Wikszemski, Dalla Rossa, Meyer, and Browning.[2]

As starch is insoluble in alcohol and cold water, it becomes hard when injected into the blood-vessels simply by the exudation of the liquid with which it is mixed. (That the starch grains forming the mass remain entirely unchanged may be easily demonstrated by making a microscopic examination of the contents of an injected vessel.)

The mass originally recommended by Pansch consisted of wheat-flour and cold water, to which was added a sufficient quantity of the desired coloring matter. Later experiments have shown that pure starch is better than flour.

[1] By Professor S. H. Gage.

[2] See Ad. Panch, "Archiv. für Anatomie und Entwickl.," 1877, pp. 480–482, and 1881, pp. 76–78; Wikszemski, same Journal, 1880, pp. 232–234; Dalla Rossa, same, pp. 371–377; Herm. von Meyer, same, 1882, pp. 60, 61, and 1883, pp. 265, 266; Browning, "Annals of Anatomy and Surgery," 1884, pp. 24, 25.

MASS FOR ORDINARY INJECTIONS.

Dry starch ("laundry" is good)	1	vol.
2½ per cent aqueous solution of chloral hydrate	1	"
95 per cent. alcohol[1]	¼	"
Color	¼	"

Since almost any animal injected may afford some organ worth preserving, it seems better to employ permanent colors for tingeing the mass. Among those which are available, probably vermilion, red lead, ultramarine, chrome orange, yellow, or green, are preferable.

PREPARATION OF THE COLOR.

Dry color	1	vol.
Glycerine	1	"
95 per cent alcohol	1	"

To avoid lumps, which would clog the cannulæ, or small vessels, the color is thoroughly ground with the liquid in a mortar. It is stored in a well-stoppered bottle, and is prepared for use simply by shaking.

Special Mass.—For the injection of brains, and, perhaps, for other rapidly perishing specimens, it seems best, as suggested by Professor Wilder, to use strong preservatives in preparing the mass:

Corn starch (that used for food)	1	vol.
5 per cent aqueous solution of chloral hydrate	½	"
95 per cent alcohol	¾	"
Color	¼	".

For convenience and economy, a considerable quantity of either of the masses described above may be prepared at once, and kept in a wide-mouthed specimen or fruit jar. A smooth stick in each jar is convenient for stirring the mass, which should always be done just before using. The syringe may be filled directly from the jar, and any mass remaining in the syringe after the injection is finished may be returned to the jar.

If it is desired to have the mass enter very fine vessels, some of the stock mass, as given above, diluted with an equal volume of water or chloral solution, may be injected first, and immediately followed by the undiluted mass, or, for large animals, a mass containing twice the usual amount of starch. In whatever form the starch is used, it is necessary to work somewhat expeditiously, because the exudation of the liquid in the smaller vessels takes place so rapidly that the mass hardens very quickly in them. The larger the vessel, the more slowly, of course, do the exudation and, consequently, the hardening take place. It sometimes happens that large vessels, like the aorta, are not fully distended after the exudation of the liquid. In this case some mass containing double the ordinary amount of starch can be advantageously injected in two hours or longer after the first injection.

[1] The chloral and alcohol prevent fermentation in the mass when it is kept in stock; the alcohol also increases the fluidity and likewise the more rapid hardening in the vessels; both, of course, act as a preservative upon the animal injected.

Dry Preparations.—Finally, if vessels injected with the starch mass are dissected free, soaked a day or two in Wickersheimer's preservative, and then dried, they retain their form, and, to a great degree, their flexibility.—*From the New York Medical Journal, June 7, 1884.*

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SCIENTIFIC NEWS.

— The Paris Museum of Natural History.—We are accustomed to think that they do things better in France, yet it appears that the troubles which beset American museums are not unknown there. The total sum annually at the disposal of the Muséum d'Histoire Naturelle is but 918,942 francs, or about $180,000. Out of this nineteen professors, fifty-six assistants and a great number of gardeners, draughtsmen, librarians, clerks, secretaries, curators, laboratory helps, etc., as well as the entire cost of maintaining the Jardin des Plantes, with its conservatories and menagerie, have to be paid. Thus, according to M. Freney's report there are no laboratories for the chairs of botany, geology, mineralogy or comparative pathology; only 40,000 francs are available for the purchase of animals; the new zoölogical galleries are unfurnished; there is no botanical gallery, though there is a considerable botanical collection; there are no available funds for the utilization of the ground that has been acquired in the Bois de Vincennes for the purposes of culture; there is no marine zoölogical station attached specially to the museum; the galleries of palæontology and anatomy need improvements; an additional assistant is required to classify the insects and crustacea, and another for the annelids, mollusks and zoöphytes; and the anthropological gallery and library need enlargement. The library has 100,000 volumes, while the gallery which contains it was built to receive 30,000. Moreover, some of the aides-naturalistes ought to have superior positions opened to them, for, as occurs elsewhere, men desert the pursuit of natural history because of the insufficient remuneration it affords.

— A cable despatch announces the death in Vienna, of Ferdinand Von Hochstetter, the noted German traveler and geologist. Herr Hochstetter was born at Esslingen, April 30, 1829. He was the son of a learned clergyman, who designed him for the same profession, but after having taken a course of theology at Tubingen, and received the degree of doctor of philosophy, Ferdinand went to Vienna in 1853, and the following year became attached, in the position of geologist, to a scientific commission sent to Bohemia. On his return he was made professor of geology in the Vienna University, and in 1856 he accepted an offer to accompany the *Novara*, in the capacity of geologist, on the expedition around the world. On his return from this expedition he was made professor of mineralogy and geology in the Polytechnic Institute of Vienna. He afterwards made several voyages, and

gathered many important and interesting data, in Switzerland and Italy in 1863, European Turkey in 1869, and in Russia and the Ural mountains in 1872. Herr Von Hochstetter was elected president of the Vienna Geographical Society in 1866, and a member of the Academy of Sciences in 1870. He became intendant of the Vienna Museum of Natural History in 1876. Among his works are "Carlsbad, a Geological Study," "The Mammoth Fossil Birds of New Zealand," "The Geology of New Zealand," "The Palæontology of New Zealand," "A Voyage in Roumania," "The Geology of the Eastern Part of Turkey in Europe," and "Across the Urals."

— The distinguished Danish entomologist, Professor J. C. Schiödte, died at Copenhagen early in June, aged sixty-nine years. He was the author of a beautifully illustrated essay on the mouth-parts of certain Isopod Crustacea, and especially of numerous memoirs on the transformations of the Coleoptera, published in successive volumes of the zoölogical journal which he so carefully edited. This is the continuation of Kroyer's *Naturhisktorisk Tidsskrift*, and for the value of its contents and the beauty of its copper and steel plates, is second, perhaps, to scarcely any other periodical published in Europe, unless we of course except the *Zeitschrift für wissenschaftliche Zoologie*. We had the pleasure, in 1872, of visiting Professor Schiödte, then in charge of the entomological department of the Royal Zoölogical Museum of Copenhagen, and well remember the superb collection illustrating the transformation of beetles which he had amassed. In his death entomology loses one of its most careful and able students.

— Dr. W. K. Brooks writes us concerning the statement in the June NATURALIST that the Annisquam laboratory is the only marine zoölogical laboratory which is now open to the public in America, that the marine laboratory of the Johns Hopkins University has for six years been open to all qualified persons. "I send you a copy of the last annual report of the president which contains an appendix from which you will see that many students from various parts of the world have made use of it." We should have added that we had reference to beginners rather than advanced students, supposing that the Johns Hopkins University School was open to the latter alone.—EDS.

— In an article entitled "Pile-dwellings on hill-tops" in *Nature* for June 19, Mr. S. E. Peale gives a new and rather prosaic cause or reason for building houses on piles, *i. e.* "the absolute necessity of keeping out of reach of the ever-present pig!" This applies to the hill-tribes of Assam and vicinity; these pile-builders having probably descended from the pre-Aryans of the plains from Assam to the Indus. There is no building-stone where the piles are used.

— Through the efforts of M. Marion, the mayor and municipal

council of Marseilles have decided upon the publication of the Annals of the Marseilles Museum of Natural History, and have established a marine zoölogical station at Eudoume Point. This establishment, devoted to the study of the Mediterranean deep sea fauna, will have an underground aquarium, protected from the abrupt changes of light and temperature.

— The report of the National Academy of Sciences, for the year 1883, has been issued by the Government Printing Office. Appendix D is a list of official reports made to the Government by the academy, and of scientific papers presented to the academy from 1863 to 1883. Succeeding appendixes contain reports on methylated spirits and on glucose.

— Bulletin No. 20 of the U. S. National Museum is devoted to a list of the published writings of Professor S. F. Baird. The number of articles is 1063, including the notices, abstracts and reviews in *Harper's Magazine*, *Harper's Weekly*, and reprinted in their Annual Record of Science and Industry.

— The death of Dr. G. von Boguslawski, known as a geographer and hydrographer, occurred in June. Professor J. H. R. Goeppert, well known for his works on fossil plants, died at Breslau, May 18. Professor Schoedler, author of "Buch der Natur," died at Mainz, April 27.

— Among recent deaths is that of H. G. Vennor in June last, at the age of forty-three. He published a useful work on the birds of prey of Canada, and was connected with the Canadian Geological Survey. He was popularly known by his attempts at "weather prophecy."

— M. Fournier, a French botanist, recently died, leaving his "Flora of Mexico," which he was preparing for the French government, and that of Brazil, which he was collecting for the emperor, unfinished.

— The fifth annual report of the curator (Edward T. Nelson) of the museum of the Ohio Wesleyan University, shows that the curator's usual activity has been manifested in increasing, labeling, and arranging the collections, particularly of shells.

— At the last session Congress appropriated $501,470 for the U. S. Coast Survey; $467,700 for the U. S. Geological Survey; $244,500 for the U. S. Fish Commission, and $149,500 for the National Museum.

— The palæontological expedition of Princeton College is this year exploring the Eocene basin of the Big Horn under direction of Professor W. B. Scott.

— Professor H. C. Lewis gave field instruction to a large class near the water-gap of the Delaware river, Pennsylvania, this summer.

— Dr. H. E. Sauvage, of the Jardin des Plantes, has been appointed director of the Agricultural Station at Boulogne-sur-Mer.

—Professor O. A. Derby is successfully exploring the geology of Brazil.

THE
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VOL. XVIII.—*OCTOBER*, 1884.—No. 10.

THE NORTH AMERICAN GEASTERS.

BY A. P. MORGAN.

THE Geasters are the most beautiful and attractive of the puff-balls, yet they seem not to be well understood. Most of them grow in woods about old stumps and rotten logs; others grow among the old leaves, and are found expanded on their surface; *G. minimus* grows in meadows and grassy lands.

They begin in a globose or ovoid form with a pointed apex; they make a slow growth just beneath the surface of the ground or under the leaves, often remaining closed for a long time; finally, with abundant rains in late summer or early autumn, they expand their segments and lift their puff-balls into the air. They dry up quickly and disappear with the clearing weather, so that specimens must be secured promptly after they have expanded. *G. limbatus*, however, with us is found very late in autumn and during the mild rainy weather in winter.

The species are more or less gregarious in habit, though some of them often occur singly. I have found more than twenty of the great *G. triplex* in one nest together. *G. saccatus* is found commonly scattered about upon the leaves, sometimes in great numbers; its mycelial threads run out over their surface from the little eggs.

Several of the species appear to be generally distributed, as *G. limbatus*, *minimus*, *fimbriatus*, *saccatus*, *hygrometricus*, and when the species are better known it is quite likely others will be found in every part of the country. *G. fornicatus*, *radicans*, *rufescens* are southern in their range. The beautiful *G. umbilicatus* has been found only in New Jersey by Mr. Ellis; it is No. 110, *G. mammosus* Chev., of the N. A. Fungi, but this is not possible

on account of the size of the spores, which in the latter are .009$^{mm.}$ *G. bryantii* is reported from New York by Professor Peck. *G. fibrillosus* grows in Pennsylvania and Carolina. *G. linkii* does not appear to have been recorded since the time of the great de Schweinitz. *G. triplex* grows abundantly about Cincinnati, and Mr. Foerste found it near Detroit. *G. striatus, vittatus, lagenæformis* have been found only in the Miami valley, but the two latter appear to me to be only fairly marked forms of *G. saccatus*, and will probably be found along with it elsewhere.

Our *G. limbatus* is the *G. multifidum* DC., of the Scottish cryptogamic flora and on the cover of *Grevillea;* but the *G. limbatus* of *Grevillea*, Vol. II, Plate XVII, must be something else. The wonderful *G. coliformis* Pers, with many pedicels and numerous mouths, has not yet been found in this country.

Geaster Mich., *Earth Star.*—Receptacle double, consisting of an outer and an inner peridium, growing separately and persistent. Outer peridium fleshy-coriaceous, thick, stellately divided into several segments; inner peridium papyraceous, dehiscing by a mouth at the apex; spores globose, brown, mostly echinulate.

Fig. 1.

1. Fornicati.

Outer peridium double, separating into an outer and an inner coat.

1. *G. fornicatus* Fr.—Inner coat vaulted, the segments reflexed; inner peridium pedicellate, the mouth conic-striate (Fig. 1).

The two coats of the outer peridium separate even to the tips of the segments; the outer coat remains firmly attached to the soil while the inner becomes vaulted over it by the bending backward of its segments; the inner peridium is thus uncovered and lifted on high upon its pedicel. Segments 4–5, rarely more; inner peridium subglobose or depressed, more or less contracted at the base; the mouth always prominent conic cylindric, ½–1 inch in diameter; spores .0035–.0040$^{mm.}$

2. *G. radicans* B. & C.—Inner coat vaulted, the segments reflexed; inner peridium subpedicellate, the mouth ciliate, fimbriate.

The inner coat is lifted up and vaulted on the tips of the outer coat as in *G. fornicatus*. The outer peridium arises out of rooting fibers; inner peridium reddish, very shortly pedicellate, about ¾ of an inch in diameter; the mouth silky as in *G. fimbriatus*.

3. *G. triplex* Jungh.—Inner coat detached about the middle and forming a cup; inner peridium sessile, the mouth ciliate-fimbriate (Fig. 2).

Fig. 2.

In this species the inner coat is not separated at the base or on the upper portion of the segments, but simply breaks away enough to form a cup about the inner peridium. Outer peridium 4–6-parted, the segments revolute; inner peridium pallid, globose or depressed, ¾–1½ inches in diameter; spores .0050–.0055^{mm}.

2. Striati.

Outer peridium single, multipartite, the segments revolute; inner peridium subsessile, the mouth sulcate-plicate.

4. *G. striatus* DC.—Inner peridium subpedicellate; the mouth prominent, conic, sulcate-striate (Fig. 3).

Segments of the outer peridium 7–9, nearly equal, acuminate; pedicel various, often very short. Inner peridium globose, smooth or at first punctulate, umber-brown, ½–¾ of an inch in diameter; the mouth prominent, plicate; spores .0035-.0040^{mm}.

Fig. 3.

5. *G. umbilicatus* Fr.—Inner peridium sessile; the mouth plicate-striate, in a compressed marginate disk (Fig. 4).

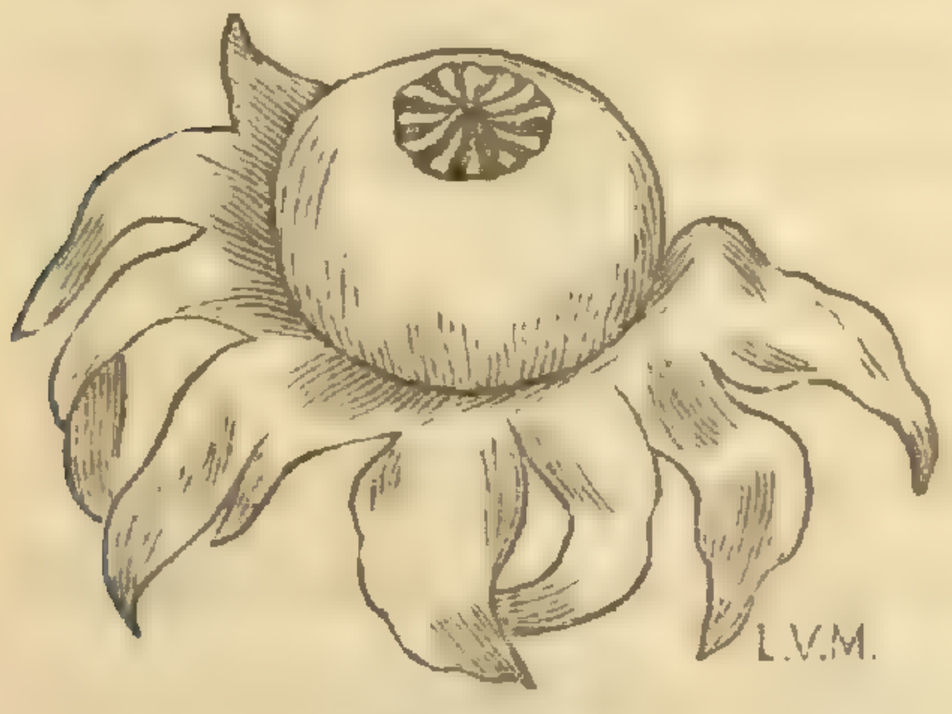

Fig. 4.

Segments of the outer peridium 7–10, unequal, sublanceolate. Inner peridium globose or depressed globose, blackish umber, about ½ an inch in diameter; the mouth conic, plicate-striate, in a circular depressed marginate umbilicus; spores .0035–.0040$^{mm.}$

3 Limbati.

Outer peridium single, expanded, multifid; inner peridium pedicellate.

6. *G. bryantii* Berk.—Inner peridium pedicellate, the pedicel with a circumscissile sheath; mouth conic, sulcate-plicate (Fig. 5).

Fig. 5.

Outer peridium concave or vaulted underneath the base; segments 8–10, unequal, acute, inflexed at the apex; a tubular sheath surrounds the pedicel, which bursts as the plant expands, the upper part remaining as a ring about the summit of the pedicel. Inner peridium subglobose, brown, ¾–1 inch in diameter, the mouth prominent, conic, plicate; spores .0040–.0045$^{mm.}$

7. *G. limbatus* Fr.—Inner peridium pedicellate, the pedicel solid; mouth depressed, subacute, fimbriate pilose (Fig. 6).

The outer peridium is concave or vaulted, and the segments inflexed as in *G. bryantii*, but there is no tubular sheath about the pedicel; the pedicel is short, a little thickened upward, passing into the inner peridium. Inner peridium subglobose, brownish,

often constricted above base so as to form a circular groove, ¾–1 inch in diameter; spores .0040–.0045$^{mm.}$

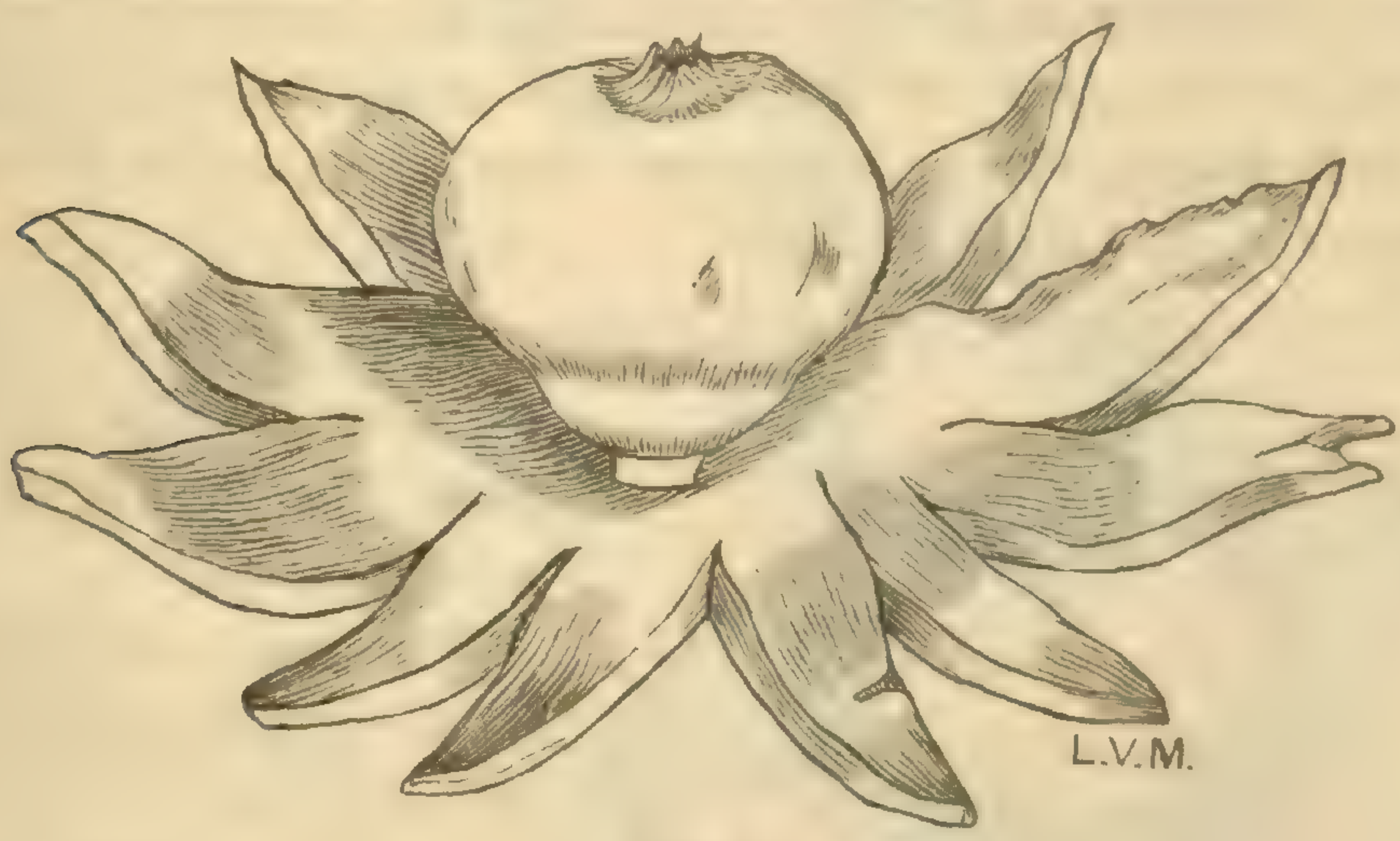

Fig. 6.

8. *G. minimus* Schw.—Inner peridium subpedicellate, white; the mouth plano-conic, ciliate (Fig. 7).

Fig. 7.

Outer peridium with a vaulted base, white beneath; the segments 7–9, "elegantly revolute," brownish where they touch the soil, with an expanse of about ½ an inch. Inner peridium ovoid with a plane base, glabrous, pure white, about ¼ of an inch in diameter; spores .0040–.0045$^{mm.}$

4. Fimbriati.

Outer peridium multifid, the segments revolute; inner peridium sessile, the mouth ciliate-fimbriate.

9. *G. fimbriatus* Fr.—Inner peridium globose or depressed globose; the mouth indeterminate, piloso-fimbriate (Fig. 8).

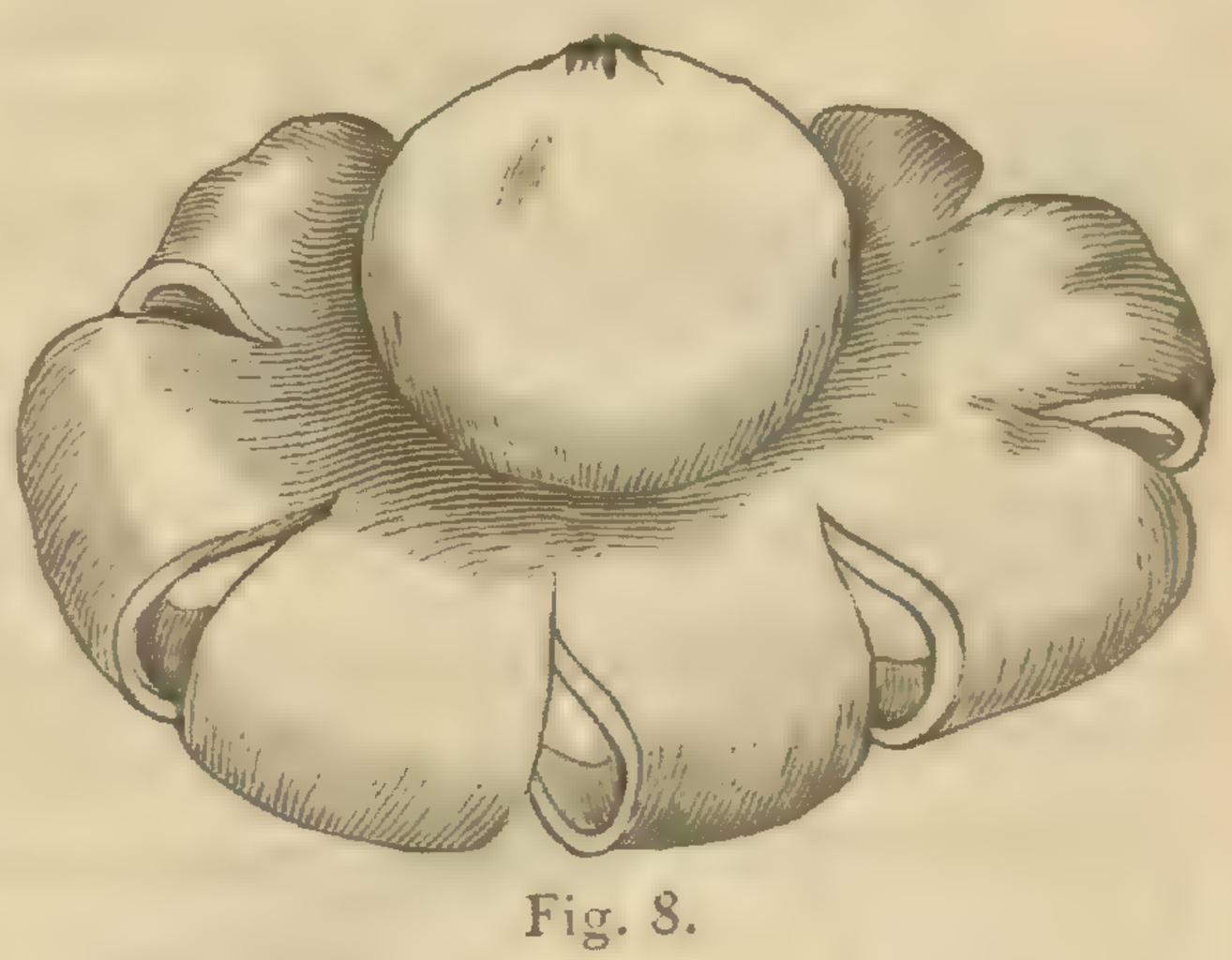

Fig. 8.

Segments of the outer peridium 6–8, equal, acute, flaccid, the superior stratum receding. Inner peridium wanting the paler circle in which the determinate mouth of other species is situated, ¾–1 inch in diameter; spores .0030–.0035$^{mm.}$

10. *G. vittatus* Kalch.—Lower surface of the segments longi-

tudinally rimose, so as to appear white-vittate; inner peridium globose or depressed globose, the mouth determinate.

Outer peridium vaulted at the base; the segments 6–9, regular, long acuminate, the inferior side subglabrous, alutaceous: the vittæ simple, linear, somewhat parallel, ½–¾ of an inch in diameter; spores .0030–.0035$^{mm.}$

11. *G. saccatus* Fr.—Outer peridium saccate; inner peridium globose or depressed globose, the mouth determinate (Fig. 9).

Fig. 9.

The outer peridium has a roe-shaped base inclosing the inner as in a cup; the outer cuticle has a leathery softness as well as color; segments 6–9, from a rather broad base tapering to a long and narrow point, more or less erected or inflexed in dryness. Inner peridium pallid or brownish, ½–¾ of an inch in diameter; spores .0030–.0035$^{mm.}$

12. *G. lagenæformis* Vitt.—Inner peridium ovoid, the mouth determinate; spores smooth (Fig. 10).

Fig. 10.

Segments of the outer peridium 6–9, nearly equal, ovate, acuminate, the inner stratum receding. Inner peridium pallid or brownish, ½ an inch or less in diameter; spores .0030–.0035$^{mm.}$

5. Dentati.

Outer peridium multifid, the segments revolute; inner peridium sessile, the mouth dentate.

13. *G. rufescens* Pers.—Inner peridium subovoid, the mouth determinate (Fig. 11).

Exterior peridium firm persistent, at first saccate, at length all resolute. Exceedingly variable in size; a rufous color prevails in the flesh of the segments and the inner peridium; spores .0040–.0045$^{mm.}$

Fig. 11.

6. Hygrometrici.

Segments of the outer peridium becoming rigid and inflexed; inner peridium sessile, the mouth lacerate.

14. *G. hygrometricus* Pers.—Outer peridium multipartite, thick, glabrate; inner peridium subreticulate (Fig. 12).

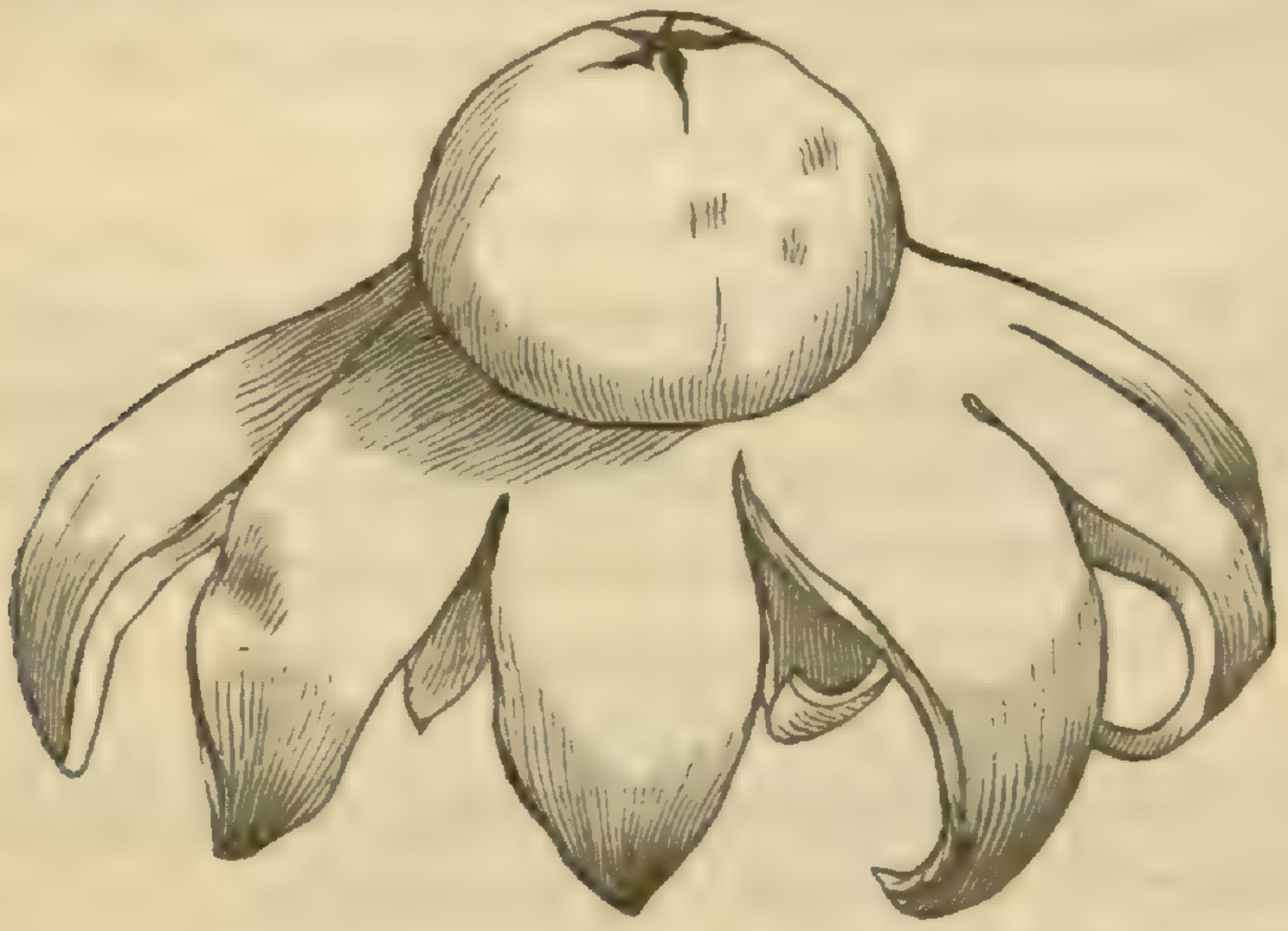

Fig. 12.

Outer peridium exceedingly thick and rigid; externally canescent, somewhat woody; lined inside by a stratum, thick, subdiscrete, brownish, waxy, cracked when dry. Inner peridium scurfy or reticulate, brown then canescent, ¾–1 inch in diameter; spores large, .008–.010$^{mm.}$

15. *G. fibrillosus* Schw.—Outer peridium multipartite, externally fibrillose-scaly; inner peridium smooth.

Related to the preceding, but the segments more numerous, acuminate, externally often elegantly areolate, with fibrils, rufescent within. Inner peridium not reticulate, subglobose. It is said to be about two inches broad when expanded.

16. *G. linkii* Spreng.—Both the inner and outer peridia at first fleshy then rigid and multifid.

Schweinitz found this species not rare in Pennsylvania; he declares it does not belong to the Geasters and gives it as *Actinodermium sternbeckii* Spf. He says it frequently grows cæspitosely, 3–4 individuals connected by roots; the expanded segments sometimes attain a breadth of more than half a foot. It must be a remarkable fungus.

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ON CATAGENESIS.[1]

BY E. D. COPE.

I. The Evolution of Organisms.

THE general proposition that life has preceded organization in the order of time, may be regarded as established. It follows necessarily from the fact which has been derived from palæontological investigation, that the simple forms have, with few sporadic exceptions, preceded the complex in the order of appearance on the earth. The history of the lowest and simplest animals will never be known on account of their perishability; but it is a safe inference from what is known, that the earliest forms of life were the rhizopods, whose organization is not even cellular, and includes no organs whatever. Yet these creatures are alive, and authors familiar with them agree that they display, among their vital qualities, evidences of some degree of sensibility.

The following propositions were laid down by Lamarck, as established by facts known to him, in 1809:[2]

I. "In every animal which has not passed the term of its development, the frequent and sustained employment of an organ, gradually strengthening it, develops and enlarges it, and gives it power proportional to the duration of its use; whilst the constant disuse of a like organ insensibly weakens it, deteriorates it, progressively reduces its functions, and finally causes it to disappear.

II. "All that nature acquires or loses in individuals, through the influence of circumstances to which the race has been exposed

[1] An address delivered before the Biological Section of the American Association for the Advancement of Science, at Philadelphia, September 4th, 1884, by E. D. Cope, vice-president.

[2] Philosophie Zoölogique, Pt. I, p. 235 (Edit. 1830).

for a long time, either by the predominant ues of an organ or by the disuse of such part, she preserves by generation among new individuals which spring from it, provided the acquired changes be common to both sexes or to those which produce new individuals."

The same proposition was previously enunciated by Lamarck in the following condensed form (Recherches sur les Corps vivans, p. 50):

"It is not the organ, that is, the nature and form of the parts of the body, which have given origin to its habits and peculiar functions, but it is, on the contrary, its habits, its manner of life, and the circumstances in which individuals from which it came found themselves, which have, after a time, constituted the form of the body, the number and character of its organs, and the functions which it possesses."

Several years ago, not having read Lamarck, I characterized the above hypothesis as the "law of use and effort,"[1] and I have subsequently formulated the *modus operandi* of this law into two propositions. The first of these is, that animal structures have been produced, directly or indirectly, by animal movements, or the doctrine of *kinetogenesis;* the second is, that as animal movements are primitively determined by sensibility, or consciousness, that consciousness has been, and is, one of the primary factors in the evolution of animal forms. This is the doctrine of *archæsthetism.* The doctrine of kinetogenesis is implied in the speculations of Lamarck in the following language (Philosophie Zoölogique, Ed. 1830, p. 239): "With regard to the circumstances which [nature] uses every day to vary that which she produces, one can say that they are inexhaustible. The principal arise from the influence of climates; from diverse temperatures of the atmosphere and of the environment generally; from diversity of location; from habits, the most ordinary movements, and most frequent actions," &c. The influence of motion on development is involved in Spencer's theory of the origin of vertebræ by strains;[2] and I have maintained the view that the various agencies in producing change mentioned by Lamarck are in the case of animals, simply stimuli to motion.[3] The immediate mechanical effect of

[1] Method of Creation, Proceedings American Philosophical Society, 1871, p. 247.

[2] Principles of Biology, II, p, 195.

[3] On the Relation of Animal Motion to Animal Evolution, AMERICAN NATURALIST, Jan., 1878.

motion on animal structure has been discussed in papers by Ryder, Hyatt, Clevenger and myself, and I have cited the evidence of vertebrate palæontology as conclusively proving such an effect."[1]

The object of the present paper is to pursue the question of the relation of sensibility to evolution, and to consider some of the consequences which it involves. It is scarcely necessary to observe that in the early stage which the subject presents at the present time, I can only point out the logical conclusions derivable from facts well established rather than any experimental discoveries not already known. And I will say here to those who object to the introduction of metaphysics into biology, that they cannot logically exclude the subject. As in one sense a function of nervous tissue, mind is one of the functions of the body. Its phenomena are everywhere present in the animal kingdom. Moreover, when studied in the inductive, *a posteriori* method, metaphysics is an exact science. As Bain observes, it is a good deal easier to foretell the actions of a man than those of the weather. It is only want of familiarity with the subject which can induce a biologist to exclude the science of mind from the field.

For the benefit of those who are not familiar with the doctrine of archæsthetism,[2] I give an outline of its implications. In the first place the hypothesis that consciousness had played a leading part in evolution would seem to be negatived by the well known facts of reflex action, automatism, etc., where acts are often unconsciously performed, and often performed in direct opposition to present stimuli. But while it is well understood that these phenomena are functions of organized structure, it is believed that the habits which they represent were inaugurated through the immediate agency of consciousness. It is not believed that a designed act can have been performed *for the first time*[3] without consciousness on the part of the animal, of the want which the act was designed to relieve or supply. This opinion accords with our knowledge of ourselves, and by irresistible inference, with our belief regarding other animals. From such familiar observation we also know that so soon as a movement of body or mind has

[1] The Evidence for Evolution in the History of the Extinct Mammalia, Am. Ass. Adv. Sci., 1883, p. 32.

[2] AMERICAN NATURALIST, 1882, p. 454.

[3] The same view is expressed by Ribot, Diseases of the Will, p. 38 (Humboldt, Libr).

been acquired by repetition, consciousness need no longer accompany the act. The act is said to be automatic when performed without exertion, either consciously or unconsciously, and in those functions now removed from the influence of the unconscious mind, such acts are called reflex. The *origin* of the acts is, however, believed to have been in consciousness, not only for the reasons above stated, but also from facts of still wider application. The hypothesis of archæsthetism then maintains that consciousness as well as life preceded organism, and has been the *primum mobile* in the creation of organic structure. This conclusion also flows from a due consideration of the nature of life. I think it possible to show that the true definition of life is, *energy directed by sensibility, or by a mechanism which has originated under the direction of sensibility.* If this be true, the two statements that life has preceded organism, and that consciousness has preceded organism are coëqual expressions.

II. Consciousness, Energy, and Matter.

Regarding for the time being the phenomena of life as energy primitively determined by consciousness, let us look more closely into the characteristics of this remarkable attribute. That consciousness, and therefore mind, is a property of matter, is a necessary truth, which to some minds seems difficult of acceptance. That it is not an attribute of all kinds of matter is clear enough, but to say that it is not an attribute of any kind of matter is to utter an unthinkable proposition. To my mind the absence of tridimensional matter is synonymous with nothingness or absolute vacuity. To say that phenomena have a material basis, is for me only another way of saying that they exist. It being granted then that consciousness is an attribute of matter, or a certain behavior of matter, it remains to trace its relation to energy, which is here used in the sense of motion. Consciousness is clearly not one of the known so-called inorganic forces. Objects which are hot, or luminous, or sonorous, are not, as is well known, on that account conscious. Consciousness is not then a necessary condition of energy. On the other hand, in order to be conscious, bodies must possess a suitable temperature, and must be suitably nourished. So energy is a necessary condition of consciousness. For this reason some thinkers regard consciousness as a form or species of energy. For my own part, in classification, I prefer to keep very different things apart. To

classify consciousness with heat, light, sound, &c., does violence to my sense of fitness and to all proper definitions. This is well shown by Professor Clifford in the following passage: "It will be found excellent practice in the mental operations required by this doctrine, to imagine a train the forepart of which is an engine and three carriages linked with iron couplings, and the hind part three other carriages linked with iron couplings; the bond between the two parts being made out of the sentiments of amity subsisting between the stoker and the guard."[1] This satire, whether intentionally or not on the part of its learned author, expresses at once the distinctive character of consciousness *in esse* and the impossibility of dissociating it from energy *in posse*. For it is sufficiently clear that while the conscious feelings of the stoker and the guard could *by themselves* do nothing for the train, such a state is essential to the energy displayed by them when they are at work for its benefit. We all understand the absurdity of such expressions as the equivalency of force and matter, or the conversion of matter into force. They are not, however, more absurd than the corresponding proposition more frequently heard, that consciousness can be converted into energy, and *vice versa*.

The energetic side of consciousness, however, may be readily perceived by a little attention to its operations. Acts performed in consciousness involve a greater expenditure of energy than the *same acts* unconsciously performed. The difficulty of a given piece of labor is in direct proportion to its novelty; that is, is in direct proportion to the amount of endeavor we use in its performance. This is another way of saying that the labor is directly as the consciousness involved. Another evidence of the dynamic character of consciousness is its exclusive and therefore complementary character. Two opposite emotions cannot occupy the mind at the same moment of time. An emotion excludes all high intellectual work, and *vice versa*.

But there is no fact with which we are more familiar than that consciousness in some way determines the direction of the energy which it characterizes. The stimuli which affect the movements of animals at first only produce their results by transmission through the intermediation of consciousness. Without consciousness, education, habits, and designed movements, would be impossible. So

[1] Scientific Basis of Morals, Humboldt Library Ed., p. 21.

far as we know, the instinct of hunger, which is at the foundation of animal being, is a state of consciousness in all animals. This incontestible fact is overlooked by the materialists properly so-called.

On the other hand, as consciousness is an attribute of matter, it is of course subject to the laws of necessity to which matter and energy conform. For instance, it cannot cause two solid bodies to occupy the same space at the same time, nor can it add one body to one body and thus make three bodies. No more can it make ten foot pounds of energy out of five foot pounds of energy, and it cannot abolish time more than it can annihilate space. These are fundamental truths which are overlooked by a majority of mankind. Moreover, nothing is more common than to hear life or mind spoken of as though it of itself is a "substance," and not as it should be as an *attribute* or condition of substance or matter.

What is then the immediate action of consciousness in directing energy into one channel rather than another? To take an illustration: Why, from a purely mechanical point of view, is the adductor muscle of the right side of the horse's tail contracted to brush away the stinging fly from the right side of the horse's body rather than the left adductor muscle? Why was the contraction-provoking energy deflected in to the right interspinal motor nerves rather than into those of the left side? Why is the ear of the horse turned forwards to catch the sound in front of him and backwards to gather the sound coming from behind? The first crude thought is, that consciousness supplies another energy which turns aside the course of the energy required to produce the muscular contraction; either as the man with the rein in his hand turns aside the horse's head, or as the shield he holds deflects a moving body. But consciousness, *per se*, that is, regarding it in its proper and distinctive definition, is not itself a force (= energy). How then can it exercise energy? Certainly no more than the bare goodwill of the train hands can pull the train. Such an explanation is to admit the possibility of making something out of nothing.

III. The Retrograde Metamorphosis of Energy.

The key to many weighty and mysterious phenomena lies in the explanation of the so-called voluntary movements of animals. I say "so-called," because true will is not at all involved in

the question. I mean the acts directed by consciousness, the acts which would not take place at all if the animal were unconscious. That there are many such acts you well know. The explanation can only be found in a simple acceptance of the fact as it is, in the thesis, that *energy can be conscious.* If true, this is an ultimate fact, neither more nor less difficult to comprehend than the nature of energy or matter in their ultimate analyses. But how is such a hypothesis to be reconciled with the facts of nature, where consciousness plays a part so infinitesimally small? The explanation lies close at hand, and has already been referred to. *Energy become automatic is no longer conscious,* or is about to become unconscious. That this is the case is matter of everyday observation on ourselves and on other animals. What the molecular conditions of consciousness are, is one of the problems of the future, and for us a very interesting one. One thing is certain, the organization of the mechanism of habits is its enemy. *It is clear that in animals, energy, on the loss of consciousness, undergoes a retrograde metamorphosis,* as it does later in the history of organized beings on their death. This loss of consciousness is first succeeded by the so-called involuntary and automatic functions of animals. According to the law of catagenesis, the vegetative and other vital functions of animals and plants are a later product of the retrograde metamorphosis of energy. With death, energy falls to the level of the polar tensions of chemism, and the regular and symmetrical movements of molecules in the crystallization of its inorganic products. Let us now trace in more detail the energies displayed by animals and plants.

It has been already advanced (see page 971) that the phenomena of growth-force, which are especially characteristic of living things, originated in the direction given to nutrition by consciousness and by the automatic movements derived from it. There remain, however, some other phenomena which do not yield so readily to this analysis. These are: first, the conversion by animals of dead into living protoplasm; second, the conversion of inorganic substances into protoplasm by plants; and third, the manufacture of the so-called organic compounds from the inorganic by plants. To these points we may return again. It is also well known that living animal organisms act as producers, by conversion, of various kinds of inorganic energy, as heat, light, sound, electricity, motion, etc. It is the uses to which these

forces are put by the animal organism, the evident design in the occasion of their production, that gives them the stamp of organic life. We recognize the specific utility of the secretions of the glands, the appropriate distribution of the products of digestion, and adaptation of muscular motion to many uses. The increase of heat to protect against depression of temperature; the light to direct the sexes to each other; the electricity as a defence against enemies; display unmistakably the same utility. We must not only believe that these functions of animals were originally used by them, under stimulus, for their benefit, but if life preceded organism, that the molar mechanism which does the work, has developed as the result of the animal's exertions under stimuli. This will especially apply to the mechanism for the production of motion and sound. Heat, light, chemism and electricity doubtless result from molecular aptitudes inherent in the constitution of protoplasm. But the first and last production of even these phenomena is dependent on the motions of the animal in obtaining and assimilating nutrition. For without nutrition all energy would speedily cease. Now the motion required for the obtaining of nutrition has its origin in the sensation of hunger. So even for the first steps necessary to the production of inorganic forces in animals, we are brought back to a primitive consciousness.

To regard consciousness as the primitive condition of energy, contemplates an order of evolution in large degree the reverse of the one which is ordinarily entertained. The usual view is, that life is a derivative from inorganic energies as a result of high or complex molecular organization, and that consciousness (=sensibility) is the ultimate outcome of the nervous or equivalent energy possessed by living bodies. The failure of the attempts to demonstrate spontaneous generation, will prove, if continued, fatal to this theory. Nevertheless the order cannot be absolutely reversed. Such a proceeding is negatived by the facts of the necessary dependence of the animal kingdom on the vegetable, and the vegetable on the inorganic for nutrition, and consequently for existence. So the animal organism could not have existed prior to the vegetable, nor the vegetable prior to the mineral. The explanation is found in the wide application of the "doctrine of the unspecialized,"[1] so clearly demonstrated by palæontology.

[1] The term specialized, introduced into biology by Professor Dana, has been used in connection with energy in creation by the author, *Penn Monthly*, 1875, p. 569.

From this point of view creation consists in specialization, an expression which describes the specific action of the general principle described by Spencer as the conversion of the homogeneous into the heterogeneous. To be more explicit, it consists of the production of mechanism out of no mechanism, of different kinds of energy out of one kind of energy. The material basis of consciousness must then be a generalized substance which does not display the more automatic and the polar forms of energy. From a physical standpoint protoplasm is such a substance. Its instability indicates weakness of chemical energy also, which suggests that the complexity of its molecule may be due to some form of energy not properly chemical. The readiness with which it undergoes retrograde metamorphosis shows that it is not self-sustaining, and furnishes a good illustration of creation of specialized substances by a running down in the scale of being. Loew and Bokorny[1] suggest that "the cause of the living movements in protoplasm is to be sought for in the intense atomic movements, and therefore easy metamorphosis of its aldehyde groups of components;" the molecular movements becoming molar, to use the language of Lester Ward. The position which I now present requires the reversal of the relations of these phenomena. Generalized matter must be supposed to be capable of more varied molecular movements than specialized matter, and it is believed that the most intense of all such movements are those of brain tissue in mental action, which are furthest removed of all from molar movements. From this point of view, when molar movements are derived from molecular movements, it is by a process of running down of energy, not of elevation; by an increase of the distance from mental energy, not an approximation to it.

The fact that the physical basis of consciousness is composed of four substances, which are respectively a monad, a dyad, a triad and a tetrad, doubtless has something to do, as I have suggested,[2] with its exhibition of this remarkable attribute. It might be supposed that the presence of carbon had the effect of restraining the chemical and physical molecular tendencies of the three other substances. From this standing-ground we may imagine

[1] Die Chemische Kraftquelle in Lebenden Protoplasma, von O. Loew u. T. Bokorny, Munich, 1882, 1.

[2] *Penn Monthly*, 1875, p. 574.

that other substances besides protoplasm might support consciousness and life. In other parts of the universe, other substances they would have to be, if consciousness exist there.

The manner in which protoplasm is made at the present time is highly suggestive. It is manufactured by living plants out of inorganic matter, the hydrogen, carbon, nitrogen and oxygen contained in the atmosphere and in the earth. As dead plants will not perform this function, this action is regarded as in some way due to the presence of life. The energy peculiar to living protoplasm, and derived primarily in part only from the sun's rays, directs energy so that the complex molecular aggregation protoplasm is the result. This is the only known method of manufacture from inorganic matter, of this substance. The first piece of protoplasm had however no paternal protoplasm from which to derive its being. The protoplasm-producing energy must, therefore, have previously existed in some form of matter not protoplasm. This is also suggested by the fact that it really antagonizes the chemical forces, and might be called, from this fact, *antichemism*. The protoplasm-sustaining energy of animal protoplasm may be a less energetic derivative, or *vice versa*. In terms of the theory of catagenesis, the plant life is a derivative of the primitive life, and it has retained enough of the primitive quality of self-maintenance to prevent it from running down into forms of energy which are below the life level; that is, such as are of the inorganic chemical type, or the crystalline physical type. A part of the energy does so run down, as can be seen in the few automatic movements of plants, and the phosphorescence of some. Also symmetrical crystals are made by some. But M. Pasteur has shown[1] that whenever the crystals are of the organic type, *i. e.*, contain carbon, they are not symmetrical but are unilateral, or, as he terms them, dissymmetrical. This indicates that the presence of carbon has restrained, a little, the absolute symmetrical automatism of the formative force.

IV. Origin of Life on the Earth.

If then some form of matter other than protoplasm has been capable of sustaining the essential energy of life, it remains for future research to detect it, and to ascertain whether it has long existed as part of the earth's material substance or not. The

[1] *Revue Scientifique*, 1884, Jan., p. 2.

heat of the earlier stages of our planet may have forbidden its presence, or it may not. If it were excluded from the earth in its first stages, we may recognize the validity of Sir William Thomson's suggestion that the physical basis of life may have reached us from some other region of the cosmos by transportation on a meteorite. If protoplasm in any form were essential to the introduction of life on our planet, this hypothesis becomes a necessary truth. Here let me refer to the fact that hydrocarbonaceous substances have been discovered in meteorites. Here also the remarkable discovery of Huggins claims attention.[1] This veteran spectroscopist has detected the lines of some hydrocarbon vapor in the spectra of interplanetary spaces. The significance of this discovery is at once perceived if we believe that hydrocarbons are only produced under the direction of life.[2]

Granting the existence of living protoplasm on the earth, there is little doubt that we have some of its earliest forms still with us. From these simplest of living beings both vegetable and animal kingdoms have been derived. But how was the distinction between the two lines of development, now so widely divergent, originally produced? The process is not difficult to imagine. The original plastid dissolved the salts of the earth and appropriated the gases of the atmosphere and built for itself more protoplasm. Its energy was sufficient to overcome the chemism that binds the molecules of nitrogen and hydrogen in ammonia, and of carbon and oxygen in carbonic dioxide. It apparently communicated to these molecules its own method of being, and raised the type of energy from the polar non-vital to the adaptive vital by the process. Thus it transformed the dead mineral world, perhaps by a process of invasion, as when a fire communicates itself from burning to not burning combustible material. Thus it has been doing ever since, but it has redeposited some of its gathered stores in various non-vital forms. Some of these are

[1] See address of C. W. Siemens, Prest. British Ass. Adv. Science, 1882; *Nature*, 1882, p. 400.

[2] Says Mr. S. F. Peckham (*American Journal of Science and Arts*, 1884, p. 105), on the origin of bitumens: "These chemical theories [of the origin of bitumens] are supported by great names, and are based upon very elaborate researches, but they require the assumption of operations nowhere witnessed in nature or known to technology. * * In the chemical processes of nature complex organic compounds pass to simpler forms, of which operation marsh gas, like asphaltum, is a resultant and never the crude material upon which decomposing forces act."

in organic forms, as cellulose; others are crystals imprisoned in its cells; while others are amorphous, as waxes, resins and oils. But consciousness apparently early abandoned the vegetable line. Doubtless all the energies of vegetable protoplasm soon became automatic. The plants in general, in the persons of their protist ancestors, soon left a free-swimming life and became sessile. Their lives thus became parasitic, more automatic, and in one sense degenerate.

The animal line may have originated in this wise. Some individual protists, perhaps accidentally, devoured some of their fellows. The easy nutrition which ensued was probably pleasurable, and once enjoyed was repeated, and soon became a habit. The excess of energy thus saved from the laborious process of making protoplasm was available as the vehicle of an extended consciousness. From that day to this, consciousness has abandoned few if any members of the animal kingdom. In many of them it has specialized into more or less mind. Organization to subserve its needs has achieved a multifarious development. There is abundant evidence to show that the permanent and the successful forms have ever been those in which motion and sensibility have been preserved, and most highly developed.

This review of the history of living organisms has been epitomized in the following language:[1] "Evolution of living types is then a succession of elevation of platforms, on which succeeding ones have built. The history of one horizon of life is that its own completion but prepares the way for a higher one, furnishing the latter with conditions of a still further development. Thus the vegetable kingdom died, so to speak, that the animal kingdom might live, having descended from an animal stage to subserve the function of food for animals. The successive types of animals first stimulated the development of the most susceptible to the conflict, in the struggle for existence, and afterwards furnished them with food."

V. Catagenesis of Inorganic Energy.

If the principles adopted in the preceding pages be true, it is highly probable that *all forms* of energy have originated in the process of running down or specialization from the primitive energy.

[1] American Naturalist, 1880, p. 266.

In the department of physics I am not at home, and touch upon it merely to carry out to a necessary conclusion the hypothesis presented in the preceding pages. It may be that physicists and chemists may find value in the suggestions which come from the side of biology. A cursory perusal of the general hypotheses current in these departments, shows that the door is wide open to receive light from this quarter. What can be offered here is of the vaguest, yet it may suggest thought and research in some minds.

In the first place it is highly probable that one of the problems to be solved by the physicists of the present and future, is that of a true genealogy of the different kinds of energy. In this connection a leading question will be the determination of the essential differences between the different forms of energy, and the material conditions which cause the metamorphosis of one kind of energy into another.

In constructing a genealogy of energies, it must be observed that we will probably obtain, not a single line of succession, but several lines of varying lengths. It must also be remembered, that as in the forms of the material world which are their expression, a greater or less extensive exhibition of all the types remains to the present day.

That the tendency of purely inorganic energy is to "run down," in all except possibly some electric operations, is well known. Inorganic chemical activity constantly tends to make simpler compounds out of the more complex, and to end in a satisfaction of affinities which cannot be further disturbed except by access of additional energy. In chemical reaction the preference of energy is to create solid precipitates. In the field of the physical forces we are met by the same phenomenon of running down. All inorganic energies or modes of motion tend to be ultimately converted into heat, and heat is being steadily dissipated into space. Therefore the result has been and will be the creation of the mineral kingdom; of the rocks and fluids that constitute the masses of the worlds.

The process of creation by the retrograde metamorphosis of energy, or what is the same thing, by the specialization of energy may be called *catagenesis*. It may be denied, however, that this process results in a specialization of energy. The vital energies are often regarded as the most special, and the inorganic as the

most simple. If we regard them, however, solely in the light of the essential nature of energy, *i. e.*, power, we must see that the chemical and physical forces are most specialized. The range of each species is absolutely limited to one kind of effect, and their diversity from each other is total. How different this from the versatility of the vital energy. It seems to dominate all forms of conversion of energy, by the mechanisms which it has, by evolution, constructed. Thus if the inorganic forces are the products of a primitive condition of energy which had the essential characteristics of vital energy, it has been by a process of specialization. As we have seen, it is this specialization which is everywhere inconsistent with life.

With these preliminary remarks we may now consider very tentatively the relations of the different kinds of energy to each other and to consciousness. In practice it is sometimes difficult to draw the line between conscious and unconscious states of energy. One reason is, that although a given form of energy may be unconscious, consciousness may apprehend the action by perceiving its results. The distinction is rendered clearer by the reflection that we can perceive by sight or touch any action of the body of whatever character. The energy of the conscious type is therefore altogether mental. The relations may be expressed as follows:

	Examples.
A. Designed (always molecular).	
I. Conscious.	
1. Involving effort	"Voluntary" acts.
2. Not involving effort	Passive perception. / Conscious automatism.
II. Unconscious.	
3. Involving mental process	Unconscious automatic.
4. Not involving mental process	Reflex.
B. Not designed.	
I. Molecular.	
5. Electric, 6. Chemical, 7. Physical,	Crystallific and non-crystallific.
II. Molar.	
8. Cosmic.	

The only strictly molar energies of the above list are the cosmical movements of the heavenly bodies. The others are molecular, although they give rise to molar movements, as those of the muscles, of magnetism, &c. Some molar movements of organic

beings are not, *in their last phases*, designed; as those produced by nervous diseases.

The transition between the organic and the inorganic energies may be possibly found in the electric group. Its influence on life, its production of contractions in protoplasm, and its resemblance to nerve force, are well known. It also compels chemical unions otherwise impracticable, thus resembling the energy of the protoplasm of plants, whose energy in actively resisting the disintegrating inorganic forces of nature is so well known. Perhaps this type of force is an early-born of the primitive energy, one which has not descended so far in the scale, as the chemism which holds so large a part of nature in the embrace of death.

Vibration is inseparable from our ideas of motion or energy, not excluding conscious energy. There are reasons for supposing that in the latter type of activity the vibrations are the most rapid of all those characteristic of the forces. A center of such vibrations in generalized matter would radiate them in all directions. With radiant divergence the wave lengths would become longer, and their rate of movement slower. In the differing rates of vibrations we may trace not only the different forms of energy, but diverse results in material aggregations. Such may have been the origin of the specialization of energy and of matter which we behold in nature.

Such thoughts arise unbidden as a remote but still a legitimate induction, from a study of the wonderful phenomenon of animal motion; a phenomenon everywhere present, yet one which retreats, as we pursue it, into the dimness of the origin of things. And when we follow it to its fountain head, we seem to have reached the origin of all energy, and it turns upon us, the king and master of the worlds.

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THE CRYSTALLINE ROCKS OF THE NORTHWEST.[1]

BY N. H. WINCHELL.

I DESIRE to call the attention of Section E to some of the interesting problems that beset the geologist who undertakes to study the crystalline rocks of the Northwest, and especially that part of the Northwest which is included in the State of

[1] Address delivered before the section of geology and geography of the Amer. Assoc. Adv. Science at Philadelphia, Sept. 4, 1884.

Minnesota. Until very recently it has been the practice of geologists, almost without exception, to refer every crystalline rock in the Northwest either to the Huronian or to the Laurentian. Thus, when the survey of the State of Michigan was reïnaugurated in 1869, the geologists of the upper peninsula were compelled to choose between a confession of their inability to establish the age of the rocks they were studying and the adoption of some of the recognized designations. In Wisconsin the case was similar, with the additional fact that the Michigan geologists were collaborators. The same was true again in Minnesota. What more natural than that the Michigan and Wisconsin rocks should be found to extend, with nearly the same features, into the State of Minnesota, and that their familiar names should at once be applied to them?

But when on more careful examination, both in the field and in the literature of the crystalline rocks, and over a wider extent of territory, and especially in the light of more recent researches in New England, New York, Pennsylvania and Canada, it is found that the nomenclature is imperfect, and furnishes but a tottering scaffold to support the workmen of a great and ever-spreading structure, we are thrown into such difficulty and doubt that we are prone either to reject the old scaffold and build anew, or to clear away the accumulated rubbish about the foundation and examine on what basis the old one stands. To-day, however, we intend to do neither of these, but rather set forth a few of the incongruities and difficulties of the actual situation.

We are indebted, unquestionably, to the geologists of Michigan and Wisconsin for the most exhaustive and satisfactory description of the crystalline rocks of the Archæan age that has yet been published in America. In order that some of the difficulties of the situation may be made clear, I desire to review concisely the broad stratigraphic distinctions of the crystalline rocks that have lately been studied in Michigan, Wisconsin and Minnesota. By the aid of the published results of the surveys of Brooks, Wright, Irving, Rominger, Pumpelly and others, a generalized statement can be formulated. To these I shall add such published results and unpublished field observations from Minnesota as may be furnished by the survey of that State, in order that the scheme may cover correctly the crystalline rocks of the entire Northwest.

Omitting the igneous rocks, which in the form of dikes cut through the shales and sandstones of the Cupriferous formation and are interbedded with them in the form of overflows, we may concisely arrange the crystalline rocks, disregarding minor differences and collating only the broad stratigraphic distinctions, in the following manner in descending order:

There are six groups:

First Group.

Granite and gneiss with gabbro.—This group is represented in Minnesota by the gabbro and red syenite at Duluth, and by the extension of this range of hills north-eastwardly nearly to the international boundary. Its thickness is unknown, but certainly reaches several hundred feet. The outcrop of red granite near New Ulm, lying under the conglomerate and red quartzite, is probably in the south-westward line of extension of this group. This group is represented by No. XX south-west of Lake Michigamme, by No. XX at Menominee and by No. I and Ia at Black river.

Second Group.

Mica schist.—This group consists of schists that are micaceous and often staurolitic as well as garnetiferous. It can be seen in Minnesota on the Mississippi river at Little Falls, and at Pike rapids. The schists are variously associated with beds and veins of granite and gneiss. This is No. XIX at Marquette, XVII to XIX at Menominee, XX to XXII at Penokee, and has a maximum thickness of 5000 feet.

Third Group.

Carbonaceous and arenaceous black slates, and black mica schists.—These sometimes pass into roofing slates, with beds of iron ore, quartzite and diorite. This group includes the black slates of the Animikie group in Northern Minnesota, of Knife lake, and Knife portage on the St. Louis river, and carbonaceous slates lately discovered near Aitkin on the Mississippi river. It includes Nos. XIV to XVII at Marquette, Nos. VI to XVII at Penokee, and Nos. XV and XVI at Menominee. Thickness 2600 feet.

Fourth Group.

Hydro-mica and magnesian schists.—Soft and obscure, becoming quartzose and also hæmatitic, also with numerous beds of

diorite. In Minnesota this is the iron-bearing horizon at Vermilion lake. It is Nos. VI to XIV at Marquette, Nos. IV to VI at Penokee, and Nos. VI to XI at Menominee. Maximum thickness 4450 feet.

Fifth Group.

This is the group of *gray quartzite and marble.* It is represented by No. V at Marquette, Nos. II to V at Menominee and Nos. I to III at Penokee. In Minnesota this horizon seems to run along the south side of Ogishke Muncie lake, near the international boundary, and perhaps includes the great slate-conglomerate which is there represented. Normal thickness from 400 to 1000 feet; but if the great conglomerate of Ogishke Muncie be included here, the thickness of this group in Northern Minnesota will exceed 6000 feet.

Sixth Group.

Granite and syenite with hornblendic schists.—This lowest recognized horizon has frequently been styled Laurentian. In Minnesota it is found on the international boundary at Saganaga lake, and large boulders from it are included in the overlying conglomerate at Ogishke Muncie lake, showing an important break in the stratigraphy. Thickness unknown but very great.

These six great groups compose, so far as can be stated now, the crystalline rocks of the Northwest. Their geographic relations to the non-crystalline rocks, if not their stratigraphic, have been so well ascertained, that it can be stated confidently that they are all older than the Cupriferous series of Lake Superior, and hence do not consist of nor include metamorphosed sediments of Silurian or any later age.[1]

This statement of the grand grouping of the crystalline terranes of the Northwest may be varied by the addition of detailed and minor distinctions and by subdivisions, but its correctness rests upon careful observations and reports of competent geologists and cannot at present be gainsayed.

Examining these groups more closely we find:

I. We have, beneath the red tilted shales and sandstones, a great *granite and gabbro group.* This has been variously regarded by different geologists. While by many early observers it was

[1] The term Silurian here is understood to cover nothing below the base of the Trenton.

classed as older than the series which has latterly been designated Huronian, and by others styled igneous and local, it has, by Brooks, been placed with that series and denominated "the youngest" of the Huronian strata, though no such rocks had ever before been mentioned as pertaining to the Huronian. By Irving it has been made the base of his Kewenawan. By Hunt it has been parallelized with the Montalban. It includes, in my opinion, the felsites and porphyries which have been styled Arvonian, and it is very certain that in many places it has passed for typical Laurentian. The gabbro is very generally admitted to be of eruptive origin, and in its great development in Canada it was once styled Upper Laurentian, and later was known as Norian. While the gabbro is certainly eruptive, the associated granite and gneiss exhibit evidences of being metamorphic in their nature. In Northern Minnesota this horizon of granite is characterized by a red color and it has an aggregate chemical composition almost identical with that of some of the associated felsites. The magnetite of the gabbro is often highly titaniferous and so abundant that the rock has attracted attention as an iron ore. The gabbro does not always appear where the granite is present, but extensive areas of granite are spread out without any sign of variation, interruption or alternation with the gabbro. In other places these two rocks are intricately and intimately mingled both horizontally and perpendicularly; but the gabbro can be considered in general as the underlying formation. Both these rocks seem to have been molten, and simultaneously so, in some places; but in the great mass of the red, granitic rock, there is a gneissic structure, and in its finely crystalline state, when it seems to vary to felsite, it exhibits a laminated structure which is evidently due originally to sedimentation. Along these laminations, and coincident with them, is a finely lined striation which exhibits the "streamed" structure, sometimes appealed to, to show the igneous nature and origin of the rock. These felsites are occasionally arenaceous, with irregularly rounded or sub-angular quartz grains, and sometimes are porphyritic with quartz and orthoclase. Veins of red granite intersect the gabbro, and the gabbro surrounds isolated masses of the granite. Transported, boulder-like masses of both are found embraced in a common paste among the later igneous outflows of the Cupriferous, where their existence is as great a puzzle as that of pebbles of red felsite and quartz-porphyry in the red conglomerates. This red granite, so far as I have observed,

generally consists largely of orthoclase, and in several instances passes imperceptibly into red felsite. It contains also quartz and hornblende, the latter generally changed by decay. The gabbro when unaffected by proximity to the red rock, consists of the three essential ingredients, labradorite, diallage and magnetite, with some necessary products of alteration, but in the vicinity of contact with the red rock it also holds orthoclase and quartz.

II. Below this granite and gabbro group is a series of strata that may be designated by the general term *mica schist group*. This is the principal, but not the only, horizon in which mica schist exists. This division is penetrated by veins and masses of red biotite-granite which appear to be intrusive in somewhat the same manner as the red granite in the gabbro overlying. However, whether this granite is exotic, or can be referred to aqueo-igneous fusion and transmission of the sedimentaries in a plastic state through fissures in the adjacent formations, is a question which still is a matter of earnest investigation. The existence of the great associated igneous gabbro is suggestive, if not demonstrative, of the presence of an adequate agent for such a metamorphism—unless it be claimed, indeed,that such an extravasation of molten rock could take place without any marked and traceable effect on the contiguous formations. These granite veins penetrate only through the overlying gabbro and this underlying mica schist. They are wanting or comparatively rare throughout the rest of the crystalline rocks. On the other hand there is an abundance of diabase and other doleritic rock, in the form of dykes, throughout all the crystalline strata. This points to the mere local nature of the origination of these granitic veins, and hence to the metamorphic nature of the granitic mass with which they are connected. It has been shown by Dana that granite suffers a change to mica schist in Western Massachusetts; Brooks as well as Emmons has shown it interstratified with limestone in St. Lawrence county, New York. They both also state that the Potsdam sandstone becomes gneissic. The same has been affirmed in Vermont by Dr. Hitchcock, and by Dr. Frazer in Pennsylvania. Hence there is no impropriety in supposing that some great change has passed over the sedimentary strata of this horizon throughout a wide extent of country reaching from the Atlantic to Lake Superior, and that in the emergences of upheaval and

dislocation the sediments of one formation were enabled to penetrate transversely into the strata of another.

This mica schist formation has an aggregate thickness of about 5000 feet, and sometimes is hornblendic rather than micaceous.

III. The next lower grand division, which is the third, might be styled the *black mica slate group.* This group contains much carbon, causing it to take the form of graphitic schists, in which the carbon sometimes amounts to over forty per cent.[1] These schists are frequently quartzose, and also ferruginous, even composing valuable ore-deposits, as at the Commonwealth mine in Wisconsin. Associated with these black mica slates, which often appear also as dark clay-slates, are actinolitic schists, the whole being, in some places, interstratified with diorite. Their estimated thickness is 2600 feet.

IV. Underneath this is a very thick series of obscure, *hydromicaceous and greenish magnesian schists,* in which, along with beds of gray quartzite, and clay slates, occur the most important deposits of hæmatitic iron ore. The lower portion of this series, which at Marquette is represented rather by hornblende and chloritic quartz-schists, and more rarely is mined as a magnetic quartz-schist, at Penokee is known as "the magnetic belt." This division of the crystalline rocks has numerous heavy beds of diorite.

V. Below this series of soft schists, which terminate downward with the magnetic iron ores, is the great *quartzite and marble group.* The marble lies above the quartzite, and in the Menominee region has a minimum thickness of at least one thousand feet; while at Marquette it graduates into a dolomitic quartzite of indefinite extent, the whole group there being essentially a quartzite. This is a most persistent and well-marked horizon. The quartzite sometimes holds feldspar, thus having an appearance of granulite. In northern Minnesota, the great slate-conglomerate of Ogishke Muncie lake seems to represent the lower portion of the great quartzite of this group, and to be the equivalent of the lower slate-conglomerate of the "typical Huronian" in Canada. In both places this conglomerate is sometimes speckled with masses of red jasper. The marble of this group appears adjacent to the conglomerate south of Ogishke Muncie lake, and in such

[1] A recent analysis of a specimen from near Aitkin, Minnesota, showed between forty-two and forty-three per cent of carbon.

a position as to overlie it, exposing a thickness of at least twenty-two feet.

Now, the difficulties of the situation arise when we cast about to find names for these parts. What are the eastern representatives of these western groups, and by what designations shall they be known?

Since the geological survey of New York, and the publication of its final report, the progress of geological science in Europe and America has rendered it necessary to revise some of the dogmas which were regarded as fundamental by the New York geologists, and to reject entirely some others. Among these may be mentioned the then current theory that the term "primary" should be applied to any massively crystalline rock, and that all such rocks belong to the bottom of the chronological scale of geology. If the apparent structural relations of the formations, as seen in the field, did not agree with this theory, some violent movement in the earth's crust was at once conjectured so as to bring nature into accordance with the true theory. Latterly, however, it has been shown abundantly by Dana and others, that the Trenton, Hudson River and other Silurian rocks are converted into crystalline schists; by Whitney that the Tertiary rocks become crystalline; by Brooks and Frazer that the Potsdam sandstone becomes gneissic; by Reusch that the clay slates, interbedded with the granites and gneisses of the Bergen peninsula of Norway,[1] contain characteristic upper Silurian fossils, and by Hitchcock that the Helderberg rocks of New York are involved in the crystalline terranes of New Hampshire.

These more recent crystalline series, however, can all be considered as excluded from the scope of search for any parallels to the crystalline groups of the Northwest. Our inquiry will involve only the well-known names Laurentian, Huronian, Taconic Montalban, Arvonian, Norian.

We meet at the outset with the question which has now become as historic in American geology as the Cambro-Silurian controversy in England, and which concerns very nearly the same geological horizon, viz: Is there a formation such as claimed by Emmons—the Taconic? On this geologists are yet divided. We conceive, however, that the division is caused, not so much by doubt as to the existence of a sedimentary fossiliferous formation

[1] Lesley, Report C4.

below the New York system, and separating it from the "primary," as by doubt as to which and how many of these sub-Silurian strata are to be included in the designation of Taconic. Having now however, given the subject very careful consideration, I am ready to state my very positive conviction that Dr. Emmons was essentially right, and that the Taconic group will have to be recognized by geologists and adopted in the literature of American geology.

Dr. Emmons, in 1842, issued the first that appeared of the volumes of the final report of the New York survey. In that volume he formally sets forth the Taconic system, although, as he admits, in an imperfect manner, the area in which the rocks exist not being in his (the second) district. In this first presentation of the system he extended it geographically too far east, and unfortunately chose a name for it which is appropriate only to a part of that eastward extension. We are indebted to the researches of several volunteer geologists, Wing, Dana, Dale, Dwight, for the disentanglement of the overlying Hudson River rocks from the true Taconic rocks, and the demonstration of the incorrectness of Dr. Emmons' eastward extension of his system in southern Vermont. Dr. Emmons' claim, however, in all its essential points, remains intact. This consists in the existence of a series of sedimentary deposits, largely metamorphic, below the Potsdam sandstone, and separating the Potsdam from the crystalline rocks known as "primary" in an orderly chronological scheme.

In his report on the agriculture of New York, issued four years after that on the geology of the second district, he makes more definite and convincing statements, going over the whole subject *de novo*. He gives diagrams showing the Taconic slates lying below the Calciferous sandrock unconformably, at Whitehall, in Washington county, a region that had been colored by Mather and Hall on their geological maps as Hudson River, and lying in the general area described by Emmons as Tacouic. He gives one also from the hills of Greenbush, opposite Albany, not far from the locality in which Mr. Ford has since discovered primordial fossils, where he also shows the Calciferous lying unconformably upon the Taconic, the former being fossiliferous. He also describes the Hudson River slates as lying unconformably on the Taconic, a fact which cannot be called in question since the recent discoveries of Wing, Dale, and Dwight, and the stratigraphic investigations of Dana. In fact, the investigations of these geologists, in-

stead of destroying the Taconic system, are only confirmatory of the published statements of Dr. Emmons in 1846.

Although the existence of the Taconic in Maine and Rhode Island, as claimed by Dr. Emmons, may not be maintained by further research, it is certain that he had the approval of Dr. Douglas Houghton in extending it into the State of Michigan. In later years, he also traced these rocks through Pennsylvania and Virginia into North Carolina. In Michigan his identifications have since been set aside and the same rocks have been denominated Huronian by Brooks, Wright, Irving and others. In North Carolina Mr. Kerr has, in the same way, substituted the name Huronian. The conclusive fact that these slates had been seen, by Dr. Houghton, in many localities, to pass beneath the Potsdam sandstone, was considered ample to supply the only important point of evidence lacking in the Hudson valley. Dr. Emmons closes his discussion by stating his theme thus, referring to the facts obtained from Dr. Houghton: "It would be difficult to add to the weight of this testimony in regard to the separate and independent existence of a system of fossiliferous rocks, of an age anterior to the Silurian or New York system."

It is not necessary to refer to the controversies that arose from the creation of the imaginary Quebec group, nor to characterize in deserved terms the attempt to bury the Taconic in the Quebec coffin. It is not necessary to quote the support which Emmons had from Barrande, nor to recount the discoveries of Mr. Ford nor the observations of Brooks in St. Lawrence county, N. Y., and Rogers in Pennsylvania, though these last both affirm that beneath the Potsdam sandstone are extensive beds of semi-crystalline strata.[1]

There may be reasons why the current literature of American geology is almost silent respecting the great work of Emmons, and why the Taconic is not known among the recognized geological formations; but we have nothing to do with these at this time. We have now only to say that it seems necessary to admit that when Dr. Emmons insisted on a great group of strata belonging to the age of the Lower Cambrian, lying below the Potsdam sandrock in New York, he had some foundation more substantial than imagination or mere hypothesis. He may have chosen an unfortunate designation. He may have but imper-

[1] Address of H. D. Rogers, 1844, before the Assoc. Amer. Geol. and Nat.

fectly understood the extent and importance of his discovery, and he may have incorrectly described its range and scope, but none of these faults, nor all of them, should deprive him of the credit of having made the discovery. He did more, he defended it to the last day of his life, and averred that "the Taconic system stands out as boldly as the Carboniferous."[1] The argument against the Taconic system which appeals to imperfect or incorrect definition by its author, will apply with equal force against the Silurian system and also against the Cambrian; also against the Huronian and the Laurentian, and perhaps with still greater force against the Hudson River, since none of these were correctly and properly defined at first by their authors.

If the equities of geological nomenclature, in the light of the results of later researches, demand of geologists of this generation a fair consideration of the claims of Dr. Emmons, that consideration must be granted. No amount of error, though heaped to the sky and supported by the highest authority, can long subsist. The truth, though tardy in asserting itself, will finally throw off the burdens under which it labors, and will shine the brighter for the darkness which preceded it.

If we examine the descriptions, given by Dr. Emmons, of his Taconic system, we shall find that he makes the following broad stratigraphic distinctions.

I. His highest member is what he designates *black slate*, which he declares, in some cases, plunges apparently beneath the "ancient gneisses" and contains a considerable amount of carbonaceous matter. In this slate, at Bald mountain, were found two genera of primordial trilobites that were described by Dr. Emmons, the much buffeted *Atops trilineatus*[2] and *Elliptocephala asaphoides*.

II. Under the black slate his next grand distinction was the so-called *Taconic slate*, which he described as argillaceous, siliceous and "talcose," the upper part being suitable for roofing and other portions adapted for flagging. It is greenish, grayish and sometimes of a chocolate color. Its grain is very fine, but in some places it is arenaceous rather than argillaceous. Thickness about 2000 feet.

[1] Letter to Jules Marcou, dated Raleigh, N. C., Nov. 6, 1860.

[2] According to Mr. Ford this is *Conochoryphe*.

III. Below this great mass of soft schists, he described, in the first place, a mass of 500 feet of limestone, designated "Stockbridge limestone," which graduates downward into "talcose" or magnesian sandstones and slates, the whole having a thickness of about 1700 feet.

IV. Under this limestone is his "granular quartz rock," more or less interstratified with slates, and becoming, in some places, an immense conglomerate with a "chloritic paste." In this conglomerate are fragments of the underlying gneiss, or

V. A formation which constituted, in his scheme, the "ancient gneiss" on which the Taconic system was said to lie unconformably.

Now it requires but a glance to perceive how closely this order coincides with that which has been independently and laboriously worked out in the Northwest. We have in both instances a "black slate" which in one case is said to be at the top of the system, but to pass apparently beneath the "ancient gneisses," and in the other is reported to be overlain by a group of mica schist and the "youngest Huronian," a mass of gneiss and gabbro. Below the black slate in both cases is an immense series of soft, hydro-mica and magnesian schists. These again are followed by limestone which in the Northwest often forms marble, and in New England sustains extensive marble quarries. This has various transitions to slate and to a hard sandrock, but in both places it becomes known, in its lower portions, as a great bed of quartzite; and finally at the base is coarsely conglomeritic with masses of rock from the great underlying series of gneiss. Were there no other precedent this very parallelism would at once be taken as demonstrative, or at least indicative, of equivalence of age. The "Stockbridge limestone," however, at Stockbridge, seems to be of the Trenton age, according to Professor Dana; and where it appears in the Taconic mountains, farther south and west, it is assumed by him to be of the same formation. But no one can affirm safely that the Taconic range of mountains is made up of the Trenton and Hudson River formations till the crucial test has been applied to them successfully in the discovery of the characteristic fossils, and assuredly not, in the absence of this test, in the face of the foregoing parallelism with a limestone known to lie much lower; and in the face of the discovery of primordial fossils in Bald mountain some miles fur-

ther north in Washington county, New York. It is to be remembered, also, that the schists of Mt. Washington are distinctly different from those of Southern Vermont containing the Trenton fossils found by Mr. Wing, "a change" taking place in them not far south from the point at which the fossils were found, continuing thence to the southern extremity of Mt. Washington.[1]

We are now, however, confronted with another difficulty. The geologists of Michigan and Wisconsin have set aside Dr. Emmons' identification of the Menominee rocks with the Taconic in 1846, and have called them Huronian, the same that has been done in North Carolina by Mr. Kerr, parallelizing them with the Canadian system, which in 1855 was so named by Dr. T. Sterry Hunt.[2]

It becomes necessary, therefore, to ascertain of what the Huronian consists. Dr. Hunt sets out with the statement that it was designed to include the younger and unconformable series of metamorphic rocks found on the shore of Lake Huron and in the valley of the Thessalon river, "and also the so-called volcanic formations of Lake Superior." Thus the avowed intent was the same as that of Dr. Emmons in erecting the Taconic system. If we seek for the actual stratigraphic and mineralogical characters of these rocks, we shall find them in the geological reports of the Canadian survey, particularly that of 1863.

In descending order the original Huronian consists of the following strata, disregarding the diorites and other "greenstones," all of which are thought by Logan to be of igneous origin, though included in the thickness given.

White quartzite	400 feet.
Limestone	200 "
White quartzite	1500 "
Limestone, siliceous and cherty	400 "
White quartzite	2970 "
Red jasper conglomerate	2150 "
Red quartzite or conglomerate	2300 "
Slate conglomerate	3000 "
Limestone	300 "
Slate conglomerate	1280 "
White quartzite	1000 "
Chloritic and epidotic slates	2000 "
Gray quartzite	500 "
Total	18000 "

[1] Dana *Am. Jour. Sci.* (3), XVII, 376.

[2] Equisse geologique du Canada; Azoic rocks, Rep. E, p. 72.

Of this series of 18,000 feet 900 feet consist of limestone; 2000 feet consist of "chloritic and epidotic slates," and 17,100 feet consist of quartzite and conglomerate. Perhaps 5000 feet of this thickness may be considered intrusive, consisting of diorite and other forms of "greenstone." This will leave 12,000 feet, at least, for the aggregate thickness of quartzite and conglomerate, being nearly double that observed in the same horizon in Northern Minnesota.

It is plain to see that if there be any parallelism between these beds and the various groups made out in the Northwest, the whole of these strata must he made the equivalent of Group v, or the *quartzite and marble group*. The 2000 feet of chloritic and epidotic slates, represented as near the base of the original Huronian, followed as they are by an immense thickness of conglomerate and slate-conglomerate, are anomalous unless there be below them other slate-conglomerates. This, indeed, is very probable, since on the shore of Lake Superior, near the mouth of the River Doré, according to the same authority, the lowest part of the Huronian is seen to consist of a green slaty conglomerate, containing "boulders" of granite and gneiss.

The extension of the term Huronian from the horizon of the original Huronian, upward through the overlying groups, may be justified by the expression of the original intent in the application of the term, but it certainly seems not warranted by any description of rocks by the Canadian geologists, nor by any claim that has usually been put forth by the authors of the name.

There is, therefore, a conflict between the Taconic and the Huronian, both in respect to the horizon which they are intended to cover (both being referred by their authors to the Lower Cambrian) and in the horizon of rocks which they actually compass. The Huronian, however, in its original and typical description, can be parallelized with only the very lowest of the strata that were included in the typical and original Taconic; while the Taconic stretches upward at least as far as to include the fourth and third grand groups made out in the Northwest, that is to say, the *hydro-mica and magnesian schists*, and the *carbonaceous and arenaceous black slates*.

This leaves two series of rocks untouched by the scope of either the Huronian or the Taconic, as these systems were at first defined; namely the *mica schist group*, and the *granite and gneiss*

with gabbro group. In the term *Montalban* proposed for these groups by Dr. Hunt, the two are united and the constant distinctness which they seem to maintain is not recognized. The granite and gabbro group has affinities with the onlying *Cupriferous rocks*, and perhaps, as Irving has suggested, should be considered the base of that series which Brooks has named "Kewenawian," whereas the mica schist group has affinities with the underlying groups, and has, without exception, been assigned to the same system and age as those underlying groups. The granite and gabbro group has likewise been designated differently. The gabbro, being an igneous rock, varies much in its prevalence and in its apparent relation to the granite. Its greatest development produces in Minnesota a range of low hills which extend northeastward from Duluth. Under similar circumstances, this group has received the name *Norian*, though at first called *Labradorian*, and thought to be a part of the Laurentian.[1] The granite and gneiss, also, associated with the gabbro, have received, under one of their modified conditions, the special designation *Arvonian*, on the supposition that these rocks where they so appear, are not modified conditions of granite and gneiss, but represent independent strata that lie near the bottom of the "Huronian" equal in rank to any of the other groups. I think I have shown elsewhere[2] that the Arvonian rocks are interstratified with the Cupriferous, and also that they are modified sediments of the Cupriferous. Instead of being near the bottom of the "Huronian" in the Northwest, they overlie all the groups that have been assigned to the Huronian by Irving, and constitute a part of the great series of "younger gneisses" which by Brooks has been ranked as the "youngest Huronian."

The interesting variety of nomenclature as brought out by the foregoing remarks, can be seen by a glance at the accompanying tabular arrangement, where the various parallelisms and the conflicting nomenclature are placed in adjoining columns.

It is evident from this table that at present it is a hazardous, and perhaps an impossible, undertaking to assign the groups of the crystalline rocks of the Northwest to any of the terranes that have been named further east, without violating somebody's system of nomenclature. Some of the ground has been covered

[1] It was described by Emmons under the term "Hypersthene rock."

[2] A. A. A. S. Cincinnati meeting; Minnesota Survey Rep. for 1880, p. 36; *Ibid.*, 1881, p. 110.

several times by different names, but on different hypotheses of structure, origin, and parallelism. Respecting the horizon known as "Laurentian" there is an approach to unanimity and agreement. This, however, consists more in a tacit consent to style the lowest known rocks Laurentian, than in any agreement among geologists as to the nature and composition of the strata. The Taconic of Emmons, which has been buffeted and combatted from the day of its birth, has from that very circumstance been generally ignored by geologists, because of a certain air of dubious authenticity which accompanies the word. The term Huronian has been allowed to stand and to flourish, partly because of the high authority on which it rests and the remoteness and inaccessibility of the typical locality, and partly, at first because of the non-publication of Dr. Emmons' protestation that it was the equivalent of some part of his Taconic, and later, because, after Emmons' death, as well as before, his opponents were active in spreading views adverse to the Taconic system throughout the literature of American geology. The original Huronian has grown from the dimensions of a single group (the quartzite and marble group), so as to include all the crystalline rocks lying above that group, spreading from the Laurentian to the unchanged sediments of the Upper Cambrian. This has in some cases become so obviously wrong, and has included groups of rocks so plainly extra-Huronian, that a double and triple nomenclature has been applied to a part of these upper rocks, for the purpose of relieving the term of the heterogeneous burden which it was otherwise compelled to carry. These new names, with the exception of the name Montalban, seem to be of value only as regional designations, the strata which they represent being igneous or metamorphic, and hence liable to be wanting in some places and to be non-crystalline in others. They further complicate the stratigraphic nomenclature, since they are probably only the locally modified lower parts of the New York system. Their geographic distribution in the Northwest not only indicates their stratigraphic horizon but also their limited and local existence.

In conclusion, the chief points brought out in this discussion may be stated more concisely:

1. The crystalline rocks of the Northwest are comprised under six well-marked, comprehensive groups.

2. The Taconic of Emmons, so named in 1842, and more correctly defined in 1846, included three of those groups.

3. The Huronian of Canada is the equivalent of the lowest of the Taconic groups, and the perfect parallel of only the lowest of the groups in the Northwest that have been designated Huronian.

4. The uppermost of the groups in the Northwest is local in its existence, and exceptional in its characters, and has received therefore a variety of names.

5. There is, therefore, confusion and conflict of authority in the application of names to the crystalline rocks of the Northwest.

GROUPS.	EMMONS.		HUNT.		BROOKS.	IRVING.	EQUIVALENTS IN MICHIGAN.	EQUIVALENTS IN WISCONSIN.	EQUIVALENTS IN MINNESOTA.
GROUP I. Granite and Syenite with Gabbro.	Hypersthene Rock. (Regarded as part of the Primary.)		Montalban.	Labradorian. Norian. Upper Laurentian. Arvonian.	Youngest Huronian.	Base of the Keweenawan.	XX.	I and Ia at Black river.	Duluth. Brulé mountain. Misquah hills. Beaver bay.
GROUP II. Mica Schist.					The Huronian of Brooks. 1873.	The Huronian of Irving. 1879.	XIX at Marquette. XVII–XIX at Menominee.	XX–XXII at Penokee.	Little Falls. Pike Rapids. Outlet of Vermilion lake.
GROUP III. Carbonaceous and Arenaceous Black Slate.	Taconic System. 1842–1846.	Black Slate.					XIV–XVII at Marquette. XV and XVI at Menominee.	VI–XVII at Penokee.	Animikie Black Slates. Grand Portage.
GROUP IV. Hydromica and Magnesian Slate.		Taconic Slate.					VI–XIV at Marquette. VI–XI at Menominee.	IV–VI at Penokee.	At "The Mission," Vermilion lake. Vermilion Iron Mines.
GROUP V. Quartzite and Marble.		Stockbridge Marble. Granular Quartz Rock.	The Huronian of Canada. 1855.				V at Marquette. II–V at Menominee.	I–III at Penokee.	Ogishke-Muncie lake.
GROUP VI. Granite and Gneiss with Hornblendic Gneiss.	Primary.		Laurentian.		Laurentian.	Laurentian.	Laurentian.	Laurentian.	Laurentian.

MAN IN THE TERTIARIES.[1]

BY EDWARD S. MORSE.

MAN, profoundly interested in his origin and antiquity, finds himself hampered in his investigations by the opinions and prejudices that have grown up with him.

He finds it well-nigh impossible to step outside of himself and regard himself as a mammal among hundreds of other species of mammals.

The formidable dogmas which he has erected, and perpetuated through centuries, to explain his origin, have become obstructive barriers which have had to be assailed, one after the other, to clear the way for rational investigation, and the arrogance, fury and final desperation of their defense have been only faintly portrayed by history.

The most formidable, and indeed the chief of these barriers was the one interwoven with theological dogma. Its foundation was laid fifteen centuries ago, and each century added its accumulations, until finally by violence and otherwise it became a part of man's inheritance, to assail which was to imperil his most cherished convictions. With the partial removal of these barriers, one becomes mindful of the precious evidences of man's antiquity, which have been overlooked, or forever lost; evidences all the more precious because so difficult to obtain.

These barriers being no longer obstructive, other barriers arose, having for their foundation evidence, and having for their builders men who belonged to that class which had been mainly instrumental in clearing the ground of previous obstacles.

The most important of these barriers was the one erected by Cuvier in the idea declaring that man being the last and highest of creation, and intimately associated with the present fauna, could never have been contemporary with the extinct species of mammals found in the quaternary beds. Fortified by this barrier, science repelled for a time all evidences brought forward to show that man's remains were synchronous with those of extinct mammals, and the authors of these evidences were treated with neglect and even ignominy.

The assaults of this barrier are now historic. The final and

[1]Address delivered by Vice-president Edward S. Morse, before the Section of Anthropology of the American Association for the Adv. Science, Sept. 4th, 1884.

triumphant vindication of Perthes, Schmerling and others, and the consequent overthrow of Cuvier's massive authority in this matter, are familiar to every student of archæology.

No sooner had the Cuvierian barrier against quaternary man been demolished, than smaller barriers of precisely the same nature were erected against the tertiaries.

Gaudry, while admitting the authenticity of the worked flints discovered by the Abbé Bourgeois in the miocene of Thenay, could not admit that they were those of man, because he says, "There was not in the middle of the miocene epoch a single species now extant. Considering the question from a palæontological point of view it is difficult to believe that the flint carvers of Thenay remained uninfluenced by this universal change."

Professor Dawkins[1] in a similar line of argument assumes that "man, the most highly specialized form in the animal kingdom, cannot be looked for until the lower animals by which he is now surrounded made their appearance. We cannot imagine him to have been living in the eocene age when animal life was not sufficiently differentiated to present us with living genera of placental mammals. Nor is there any probability of his having appeared on the earth in the miocene, because of the absence of placental mammals belonging to living species. It is most unlikely that man should appear in a fauna in which there was no other living mammal.

"He belongs to a more advanced stage of evolution than that presented by the mid-miocene of Thenay, in which flint splinters fashioned by man are said to have occurred. Up to this time the evolution of the animal kingdom had advanced no farther than the *Simiadæ* in the direction of man, and the apes then haunting the forests of Italy, France and Germany were the most highly organized types. We may also look at the question from another point of view. If man were upon the earth in the miocene age, it is incredible that he should not have become something else while those changes were going on in the conditions of life by which all the miocene land mammalia have been so profoundly affected that they have either assumed new forms or been exterminated. It is impossible to believe that man should have been an exception to the law of change," and for similar reasons Professor Dawkins says we cannot expect to find traces of man

[1] N. A. Review, Vol. 137, No. 4.

in the pliocene age. The student fully imbued with these opinions, the same in kind with those of Gaudry, is inclined to repudiate or modify the interpretations of all evidences bearing on man's existence before the quaternary.

That such barriers are really obstructive is plainly evident. In thus authoritatively setting a limit to man's antiquity a check is not only put upon research but, if firmly grounded in the minds of some, evidence, if met with, is mistaken or ignored.

The history of palæontology is strewn with these barriers, barriers not only limiting groups of animals to certain horizons, but repeatedly placing a limit to the dawn of life itself. How well do we recall the timeworn geological terms characterizing the different geological periods as they were recognized in our younger days, and how many thousands of vertical feet have been recovered from the Azoic and brought into orderly sequence, defined by names which are getting to be equally familiar.

As the objections to the occurrence of man in the tertiaries are in every case purely theoretical, they may, with perfect fairness, be combated on theoretical grounds.

In the theological barrier the objection to man's high antiquity rested solely on the fact that it was in direct conflict with Mosaic cosmogony, and yet this barrier, unsupported by the faintest scrap of evidence, thwarted the study of man's antiquity up to within very recent years.

In the Cuvierian barrier man was assumed to be structurally the highest mammal, and consequently must have appeared last.

In the analogous barriers of Gaudry, Dawkins and others, the assumption is that since orders, families and genera have become extinct, it is inconceivable that man should have remained unchanged while those profound modifications and extinctions were going on.

This position has been greatly strengthened by the idea that man has been evolved from the higher apes, and that his nearest relations among these creatures are those which are supposed to have appeared last in the sequence. The troublesome fact, however, confronts us that we find the evidences of man associated with extinct apes, and the gap between them is by no means closed in these earlier horizons.

Assuming that man has sprung from the same stem with the

higher apes, and assuming, moreover, that he is limited to the Quaternary, we do not find in the earlier deposits what we should have a right to expect, namely, generalized forms of man, that is, creatures that while markedly ape-like in character were unquestionably man. In the earliest remains of man, thus far recognized, we do have the most pronounced ape-like features, as in the well-known Engis and Neanderthal, and in the more recently discovered Tilbury and Podhaba skulls. But all these forms are still man, with a fair brain case whatever may be inferred regarding the depth and number of his cerebral convolutions. The modifications toward an ape-like structure, slight as they may appear, have the deepest significance in clearly indicating the direction from which he sprang.

If palæontologists are right the first anthropoid ape has been found in the Middle Eocene, and later still a more generalized form called Oreopithecus which, according to Gervais, had affinities with the anthropoid apes, macaques and baboons. Side by side with these early apes are found chipped flints, if we are to accept the authority of their discoverer, Bourgeois, and the opinion of Mortillet and others.

If man existed then, and on theoretical grounds there is no reason to believe that he did not exist, where are we to look for the approach of these two groups? Surely far beyond the limits where these evidences had hitherto been found. We must not be content to trace out the evidences of man in his work, for before the rudest flint was fashioned by him he must have used natural fragments of sticks and stones, and even this faculty must have indicated an advance far beyond that of his progenitors, who had not acquired even the habit of handling weapons. The earliest evidences must be sought for in his remains, and not in his works, and here we meet with a difficulty which unfortunately not only accompanies the remains of man and those creatures having an affinity with him, but of other groups of animals as well; conditions which have rendered the preservation of their remains a matter of chance; conditions duly recognized by palæontologists pertaining to their perishable nature, life habits or the composition of the rocks in which such and such forms must of necessity have occurred. While the remains of certain groups of animals are scattered through the rocks in the greatest profusion, of other groups, perhaps equally numerous in individuals, the

scantiest traces are met with. The very conditions of life which characterized early man and his associates, render the preservation of their remains a matter of extreme improbability. The Herbivora, in herds, seeking the shelter of watery places to avoid heat and insect annoyances would, in dying, become mired, and thus preserved in a matrix for the future explorer. The heavier mammals, like the mastodon, would become engulfed by their own weight under conditions which would preserve them, and these are not supposititious cases, but in accordance with facts connected with their discovery and preservation. Aquatic forms are infinitely more abundant as fossils than land or aërial forms. Professor Marsh, in his monograph on the fossil toothed birds of America, testifies to the extreme rarity of the remains of land birds over those of aquatic habits.

The arboreal ancestors of man, and the probable habits of man himself, would leave their bones to bleach in the field or forest, to decompose and disappear long before an entombment were possible. It was only when man acquired the art of sepulture or sought refuge in caves that the preservation of his remains became assured.

Even after man sought the shelter of caves or acquired the art of burial, surface changes have been so widespread and profound as to nearly obliterate all evidences of those places. Professor Dawkins, the eminent archæologist and geologist, says that while there have been caverns in all geological periods, they have all been obliterated by "the rain, the alternations of heat and cold, the acids evolved from decaying vegetation and the breakers on the seashore," and this abrasion and destruction has been so extensive and thorough that Professor Dawkins recalls only two caverns that can be said to be as old as the Middle Pliocene.

Even when these caves have been preserved, the harvest from them has been of the most meager description.

Schmerling, who examined nearly fifty caves in Belgium, found human remains in only two or three of them. Lund, who examined eight hundred caves in Brazil, found only six containing human remains. It would seem as if the elements had conspired to efface every record of that creature who alone takes any interest in his own origin. We survey large areas rich in the works of man, yet find no traces of the bones of man himself. The Swiss lake-dwellers we know minutely from the *débris* of their

ruined villages. Grain and even the bread they made being preserved, and yet human bones are of scanty occurrence. The Danish peat-beds have as yet never yielded human bones, though stone implements and objects of various kinds from these deposits enrich the museums of Denmark.

The shell heap deposits all over the world rarely contain human bones. It is said that none have been found in the Danish shell heaps, though Wyman found a few in the Florida shell mounds, and the deposits in Japan reveal similar traces.

Chief among the agencies in destroying the evidences of man have been the glacial floods, and these, if the glacialists are right, have occurred, one, during the earlier pliocene, and the other at the beginning of the quaternary. To these overwhelming and annihilating ice torrents, grinding, sweeping and inundating the north temperate zone, must be attributed the almost complete obliteration of records we hold most precious. And in their gradual recedence no less destructive agencies were at work in scooping out valleys, inundating immense areas and covering broad tracts of land by their detritus.

Even man to-day with his colossal works of engineering skill would in the face of a glacial flood yield the last traces of the evidences of his existence. A few corroded boulders of metal, and bits of glazed pottery alone might survive. What must such a torrent have been to primitive man with his simple and rude appliances!

It would seem from many facts that early man lived in the vicinity of water, either on the banks of rivers, or along the coast line. The reasons for this are obvious enough; food was always procurable at every receding tide and when man acquired the art of boat-making natural thoroughfares were always available and of greater necessity from the dense forests which covered the land.

Now it is just these regions that have been most profoundly modified since glacial days and indeed in all times.

Ancient river beds have been widened, lowered and obliterated. Coast lines have changed, great tracts have disappeared beneath the waves and degradations of the coast lines by the pounding of the waves has been universal.

Professor George H. Cook, state geologist of New Jersey, calls attention to the universal subsidence of the coast line from the

Carolinas to Greenland. The erosion of all the shores and islands along the coast of New England is very marked. Shell heaps are everywhere met with, cropping out and crumbling down with the decaying banks, and the records of man thus lost can never be regained.

If Saporta's idea is correct then, of course, the traces of these primitive people are buried under paleochrystic ice. Saporta suggested the idea that man, originating in the north, had been pushed southward by successive waves of people till the primitive wave was forced into the extremities of the Southern continents, and that the remnants of this ancient wave are seen in the Tasmanians, Bushmen and Fuegans.

That such a wave could be forced the length of the world, through such vicissitudes of climate and accompanying conditions, unmixed and unbroken seems incredible. Far more probable would it be to assume an antarctic continent under genial conditions in which these primitive races lived, I will not say originated, and from whence successive waves emanated, becoming modified by their new surroundings as they receded from their point of origin. The submergence of this region leaving remnants of these extraordinary, low and uniformly dolichocephalic types as we recognize them in the Patagonians, Tasmanians, Australians, Bushmen, Veddahs and others, and precisely where we might expect to find them. If either supposition is true the earlier traces of these people are forever buried beyond recovery.

In the face of all this destruction and effacement must be reckoned also the prejudices of man himself, which have caused the loss of precious material, or of opportunities which can never be regained. Ancient skeletons have been exhumed only to be promptly buried again; others encountered in excavations and left undisturbed through superstitious fear. Even at the present time the recognition of all evidences bearing on the high antiquity of man is checked by a scrutiny that oftentimes becomes well-nigh ridiculous. The collection and study of the remains of other fossil mammals goes on unchallenged. Material is collected and allotted to its proper horizon without dispute. The archæologist, however, is beset by a class who repudiate his facts, look upon his evidences as deceptive or fraudulent, and within very recent times have not hesitated to apply terms of equal opprobrium to the investigators of these things.

We are continually warned that caution should be exercised in accepting evidence not verified by scientific observers; at the same time we should be on our guard to repudiate all protests against the high antiquity of man made by those not equally well informed.

From the preceding pages it is evident that the discovery of the remains of early man, or rather of primitive man, is highly improbable; nevertheless we need not despair; other forms of animals have been equally rare for a time until some unlooked-for discovery has brought to light a rich mine of material. Until this good fortune comes to us we must be content to reason from the known to the unknown.

In regard to the physical characteristics of man, it has been wondered by Gaudry, that man could have remained unchanged while so many other forms have been modified or become extinct. That slight changes in the osteological structure of man have taken place he must admit, and that mammals of huge form and great variety have become extinct, and others profoundly modified since his appearance, is equally certain.

These facts he recognizes so far as pleistocene man is concerned, but the great disproportion in the changes that man may have undergone, and the known changes of other mammals since miocene days, seems too improbable to be accepted. On the other hand it seems reasonable to believe that the moment the ancestors of man possessed the power of banding together in communities, and of using weapons, they became capable of rendering inoperative the very influences which were so active in modifying or exterminating their mammalian associates.

How far these conditions were settled in the quaternary may be seen in the fact that while man could endure an arctic climate, his anthropoid and more distant pithicoid relations bathed in a tropical heat. Indeed the latter disappeared from Europe forever on the approach of the cold wave, while man survived.

The fact that man and his near associates have been regarded as, structurally, the highest forms of mammals, has led to the natural belief that they must have been last evolved.

That man is preëminently the highest form intellectually goes without the saying. In the words of Topinard, "The supremacy which our very exalted intellectual faculties secure to us, is confirmed to us by the existence of an exceptional development of

the organ which is its seat." Man has three or four times more brain than the highest ape. This excessive disproportion, even taking the capacity of the earliest crania, must presuppose a long line of ancestors in which this capacity was less and less.

The same progress that man and his near relatives have shown in an unparalleled degree in the development of the brain, is also remarkably conspicuous in other mammals and vertebrates lower down in the scale, as shown so admirably by Marsh.

The size of the brain case went on increasing from the earlier to the later geological periods out of all proportion to other modifications of structure.

In relation to this subject it seems that sufficient importance has never been given to the generalizations of Cope wherein he considers the relations of man with tertiary mammals, and until sufficient recognition has been accorded to these generalizations I feel justified in again bringing them forward. In these considerations Professor Cope shows that "the mammals of the lower eocene exhibit a greater percentage of types that walk on the soles of their feet, while the successive periods exhibit an increasing number of those that walk on the toes, while the hoofed animals and Carnivora of recent times nearly all have the heel high in the air, the principal exceptions being the elephant and bear families." He then calls attention to the progressive osteological changes of the foot from the earlier to the later types through several lines of descent, and says: "The relation of man to this history is highly interesting. Thus, in all generalized points, his limbs are those of a primitive type so common in the eocene. He is plantigrade; has five toes; separate tarsals and carpals; short heel; flat astragalus, and neither hoofs nor claws, but something between the two; the bones of the forearm and leg are not so unequal as in the higher types, and remain entirely distinct from each other, and the ankle joint is not so perfect as in many of them. In his teeth his character is thoroughly primitive. * * * His structural superiority consists solely in the complexity and size of the brain. A very important lesson is derived from these and kindred facts. The monkeys were anticipated in the greater fields of the world's activity by more powerful rivals. The ancestors of the ungulates held the fields and the swamps, and the Carnivora, driven by hunger, learned the arts and cruelties of the chase. The weaker ancestors of the quadrumana pos-

sessed neither speed nor weapons of offence or defence, and nothing but an arboreal life was left them, when they developed the prehensile powers of the feet. Their digestive system unspecialized, their food various, their life the price of ceaseless vigilance no wonder that their inquisitiveness and wakefulness were stimulated and developed, which is the condition of progressive intelligence." And Professor Fiske shows, on other grounds, that when variations in intelligence became more important than variations in physical structure, they were seized upon to the relative exclusion of the latter.

I am not aware that these postulates have ever been gainsaid and their admission answers the objections urged by Gaudry and others, and explains on rational grounds why man has continued to persist for so long a time with physical characteristics so slightly modified, while other forms were changing or becoming extinct.

As to his structural affinities with the higher apes, it has been shown that his relations are not only with these forms but scattered through the whole range from the gorilla down, and osteologically even with the half-apes, the lemuroids, and these in turn have affinities with those perplexing forms, the aye-aye and tarsier.

As to his osteological affinities with the Lemuroidæ, insisted upon by Mivart, it is worthy of note that these forms have been discovered in the Lower Eocene of both continents.

If these structural affinities are valid, then we must look far beyond and below the present higher apes for the diverging branches of man's ancestry. Among the many evidences of the early origin of man is the one that reveals the early establishment of well marked types which must have required an enormous lapse of time to have established. Repeatedly the evidences are brought forward, by different investigators, that the various types of skulls are met with among the earliest traces of man. Without mentioning the comparatively recent lake-dwellers of Switzerland, among whom Dr. His believes he has discovered four different types of skulls, we turn to the labors of Professor Kollman, who has made an exhaustive study of the crania of various races in both hemispheres. The results of these studies have established the existence of races of people bearing certain unchangeable characters so far back as the remains of man have

been detected. Among these races living to-day he calls attention to the Malay and Papuan existing for so long a time under similar tropical influences, and yet so markedly different in their racial characters.

From a study of the skulls, both ancient and modern, of the native races of North and South America, as well as those of other parts of the world, Dr. Kollman comes to the opinion that the sub-species of man became fixed in the preglacial period, and through the vicissitudes of time a greater or less influence has been exerted upon varieties in different areas.

Mr. Keane, in the Journal of the Anthropological Institute for February, 1880, shows that the great Asiatic types, known as the Caucasian and Mongolian, have from prehistoric times occupied the Chinese peninsula. And these evidences are continually multiplying, not only in regard to the diversity of type among early races, but to their equally wide dispersion as well.

Furthermore, the evidences go to show that early man had become sufficiently differentiated to acclimate himself to widely different regions of the earth's surface, ranging from the torrid to the arctic, while the apes were still confined to the torrid zone. The remains of his feasts show that he had early become omnivorous.

These facts in themselves indicate a wide gap then separating man from the higher apes, and add further reason for his ability to remain unaltered amid the universal change going on about him.

The most powerful argument, in favor of the belief that man must have existed in the tertiaries, lies in the very important fact that his earliest remains are not confined to any one region of the earth which might have been a centre of distribution—a paleolithic garden of Eden—but are found in all four quarters of the earth, as the rapidly multiplying evidences are testifying.

To go no farther back than the river drift men, if, with Dawkins, we admit that these are the first reliable traces of man, we find that these people were not confined to any one special region of the earth's crust, but, on the contrary, are found impartially scattered from tropical India, through Europe, to the continent of North America. They could not have been distributed through the northern approaches of the continents unless this distribution occurred in preglacial times, because, as Dawkins shows, an ice-

barrier must have spanned the great oceans in northern latitudes.

It seems an almost fruitless speculation to inquire into the manner of their dispersion, yet one is tempted to surmise that they originated in the tropics, then submerged continents must be restored to offer the means necessary for such a dispersal. If, on the other hand, their home was in the north or south temperate zone, and the distribution circumpolar, which seems most probable, then we have another evidence of the wide separation which the race had undergone, at that early day, from its tropical relatives, the apes. Whatever the facts may ultimately show, the unparalleled distribution of a people in the lowest stages of savagery proves beyond question that man must have preëxisted for an immense period of time, for, with the known fixity of low savage tribes, the time required to disperse this people over the whole earth can only be measured by geological centuries.

The farther we penetrate into the past, and ascertain some definite horizon of man's occurrence, other observers in widely different regions of the earth bring to light traces of man's existence in equally low horizons. The remoteness of man's existence in time and space is so vast that, to borrow an astronomical term, no parallax has thus far been established by which we can even faintly approximate the distance of the horizon in which he first appeared. By this fact we are justified in the assumption that the progenitors of quaternary man, under different genera possibly, must be sought for in the tertiaries.

Science will not gain by the erection of any theoretical barriers against tertiary man, until such definite forms are met with as shall reasonably settle the beds in which he first occurred.

We know in what rocks it would be obviously absurd to look for his remains or the remains of any mammal. So long, however, as forms are found, in the lowest beds of the tertiaries, having the remotest affinity to his order, we must not cease our care in scanning unbiased, even the rocks of this horizon, for traces of that creature who until within a few short years was regarded as five thousand, eight hundred and some odd years old and who despite of protest and prejudice has asserted his claim to an antiquity so great and a dispersion so profound that thus far no tendency to a convergence of his earliest traces has been demonstrated.

EDITORS' TABLE.

EDITORS: A. S. PACKARD, AND E. D. COPE.

—— Our esteemed contemporary, *Science Record*, in its issue of July 15th makes the following editorial observations:

"It is a well-known fact among naturalists that much valuable scientific work is not the result of the labors of the man over whose name it appears. There are several in this country (and many in Europe) who employ assistants who do all or nearly all of their work, including even the composition of their articles, but the names of these assistants are never mentioned. Their employers get all the credit for their work. It would seem that this shows a lack of common honesty, as it builds up a reputation at the expense of the subordinate who really accomplishes the work."

We have heard these sentiments occasionally expressed since the days of our early experience, and have never been able to give them our assent. Everything depends on the nature of the contract existing between the employer and the employed. If the latter agrees to furnish brains to the employer at so much a month, he will not, if he be a man, complain if the employer get credit for possessing greater ability than he is actually possessed of. This is, however, a kind of contract which few persons on either side of it would desire to make, and only necessity could furnish an inducement to enter into it. An employee in such an establishment is no more entitled to the credit of the proprietor than an intelligent and perhaps necessary clerk is to a share in the profits of the business of a mercantile firm. Nevertheless some persons would rather do this kind of work than be an accountant or a farm laborer. It doubtless gives more or less education, and furnishes a stepping-stone to something better.

A really reprehensible practice is that of appropriating without credit the results of the work of others which has *not* been paid for. There can be no diversity of opinion on this point, and he who does it defies his environment, and will not only gain nothing by it, but will lose a good deal of good report which he might otherwise possess.

RECENT LITERATURE.

NOTES ON THE BIRDS OBSERVED DURING A SUMMER CRUISE IN THE GULF OF ST. LAWRENCE. BY WILLIAM BREWSTER.[1]—This is the title of an important paper of forty eight pages recently issued by the Boston Society of Natural History. By way of introduction Mr. Brewster states that the expedition was organized by Professor Hyatt, and that the scientific work accomplished was done in the interest of the Boston Society of Natural History. The party, which consisted of Alpheus Hyatt, William Brewster, Samuel Henshaw, E. G. Gardiner, W. H. Kerr and E. R. Warren, set sail from Annisquam, Mass., on the morning of June 17, 1881, "in the *Arethusa*, a schooner-rigged yacht of seventeen tons, belonging to Professor Hyatt." The gulf was entered on the 24th. The places visited were Gaspé, Percé rock, the Magdalen islands, Anticosti (Fox, Wreck and Ellis bays and West End), and the Mingan island on the north shore.

Persons familiar with navigation in the Gulf of St. Lawrence will not be surprised at the statement: "The weather during most of the summer was simply abominable. Our log book records only eighteen moderately fair days out of the total sixty-two, and some of these were more or less interrupted by showers. The temperature in our cabin rarely reached 60° Fah., while it often fell below 40°, and once reached 34°; add to this the fact that, excepting during dead calms, the wind usually blew half a gale, and it becomes apparent why much of the time was wasted at safe but otherwise unprofitable anchorage. Indeed, it was by no means uncommon to spend several days waiting for an opportunity to land on some tempting shore, and when the opportunity came it was often too brief for anything like thorough work." The time and patience required for the preparation and preservation of bird skins on a small yacht during foggy weather must be experienced to be fully appreciated, and Mr. Brewster, in order to save specimens previously procured, was frequently forced to remain on board while the other members of the party were on shore.

Ninety-two species of birds are enumerated. The name of each is usually followed by a statement of its abundance at the several points visited, together with data concerning its breeding habits, and more or less extended notes of a biographical or technical character.

Concerning the song of the fox sparrow Mr. Brewster observes: "What the mocking-bird is to the South, the meadow lark to the plains of the West, the robin and song sparrow to Massachusetts, and the white-throated sparrow to Northern New England, the fox sparrow is to the bleak regions bordering the Gulf of St.

[1] Proceedings of the Boston Society of Natural History, Vol. XII, Oct. 3, 1883, pp. 364–412. Not issued till June, 1884.

Lawrence. At all hours of the day, in every kind of weather, late into the brief summer, its voice rises among the evergreen woods, filling the air with quivering, delicious melody, which at length dies softly, mingling with the soughing of the wind in the spruces, or drowned by the muffled roar of the surf beating against neighboring cliffs. To my ear the prominent characteristic of its voice is richness. It expresses careless joy and exultant masculine vigor rather than delicate shades of sentiment, and on this account is perhaps of a lower order than the pure, passionless hymn of the hermit thrush; but it is such a fervent, sensuous and withal perfectly-rounded carol that it affects the ear much as sweetmeats do the palate, and for the moment renders all other bird music dull and uninteresting by comparison."

The ruffed grouse (*Bonasa umbellus*), long known as an inhabitant of Labrador, was not met with, but Mr. Brewster "obtained some information affecting its northern range, which, if true, is important." He was told by several witnesses, whose trustworthiness is not called in question, that the species occurs, though sparingly, as far north as Hudson straits.

The greater yellow-legs (*Totanus melanoleucus*) was found breeding in numbers at Fox and Ellis bays, Anticosti, and about the mouth of the Mingan river. Concerning its actions on the breeding grounds, Mr. Brewster remarks: "Previous to the experience just related, I had supposed myself well acquainted with these birds, but I am free to confess that when I first met them at Anticosti I had to shoot several before I could believe that they were really greater yellow-legs. Not only were their flight and actions peculiar, but all their notes differed from any that I had ever heard them produce. In addition to the cry already described, they uttered a rolling *pheu-pheu-phé*, *pheu-pheu-phé*, repeated a dozen times or more in quick succession; a mellow *pheu*, *pheu*, *pheu*, resembling the whistle of the fish-hawk, and a soft, hollow *hoo*, *whoo*, *whoo*, very like the cooing of a dove. The latter note was given only when the bird perched on the top of some tall spruce, a habit by no means uncommon here, but one which I think has never been previously reported for this species."

Mr. Brewster says of the famous gannet rookery at Bird rocks: "In 1860 the number of gannets breeding on the *top* of Great Bird (then uninhabited), was estimated by Bryant at about 'fifty thousand pairs,' or one hundred thousand birds. In 1872 Maynard found this portion of the colony reduced to about five thousand birds (a lighthouse had been erected on the summit of the rock and several men were living there). When we landed in 1881 the top of the rock was practically abandoned, although there were some fifty nests at the northern end which had been robbed a few days before and about which the birds still lingered."

A couple of young kittiwake gulls (*Rissa tridactyla*), taken alive by Professor Hyatt, were the occasion of a very important discovery. "We could not induce them to drink," writes Mr. Brewster, "and in spite of every attention that could be thought of they pined rapidly. On the second day one of them died. The survivor was failing fast when some one placed him in a basin filled with salt water, hoping that a bath might prove beneficial. To our great surprise he instantly began to *drink*, swallowing draught after draught with evident satisfaction. After that there was no further trouble. He had a dish of sea water constantly within reach, and it was frequently resorted to; but we could never tempt him to take fresh water, although the experiment was tried repeatedly. * * * In view of such a development it is highly probable that the same practice obtains with other oceanic birds. * * *

"To return to our pet. He grew apace, and at the end of the fourth week was able to fly; but although he was occasionally thrown overboard for a swim, he showed no disposition to leave us. His manners from the first were singularly affectionate and confiding, and he never objected to being handled, but, on the contrary, received all caresses with a gentle playfulness that quickly won the heart of everyone. After the return of the *Arethusa* he was allowed full liberty at Annisquam, but although he made daily flights down the harbor, he invariably returned to the vessel at sunset and spent the night in the pail in which he had been reared. I saw him last about the 25th of August. When I reached the shore he was sitting on the water several hundred yards away, but in response to a familiar call he rose and flew directly to me, alighting near at hand and allowing me to take him up with every appearance of satisfaction. In his fresh fall plumage he was a beautiful bird, and his gentle ways were inexpressibly winning."

Concerning the breeding of the Wilson's petrel (*Oceanites oceanicus*) Mr. Brewster suggests a novel theory and supports it by evidence that must be regarded as conclusive. The subject is one of such importance that it demands reproduction in the author's words. Mr. Brewster says:

"But a still greater mystery is that which envelops the breeding of Wilson's petrel. I am not aware that any one has ever identified its egg or even certainly found it nesting; yet it spends the entire summer along our coast from the Gulf of St. Lawrence to Cape Henry, Virginia, and over much of this area is even more numerous than Leach's petrel. Why then have its breeding grounds remained undiscovered while those of Leach's petrel are so well known? Before attempting to answer this question I must again refer to the experience of our expedition.

"A number of Wilson's petrels, shot at various times and places between the dates June 17 and July 25, were carefully dis-

sected with a view to ascertaining their time of breeding. With all the condition of the sexual organs were similar, viz., at the very lowest stage of erotic development. The testes of the males were scarcely larger than dust shot, while the ovaries of the females presented the appearance of whitish sacs in which the separate ovules could not be clearly seen without the aid of a glass. I examined the females for signs of recent ovulation or incubation, but could find none. Furthermore, a male, taken June 18, showed every indication of being a young bird about eight or ten weeks from the nest. Its plumage differed appreciably from that of some adults shot the same day, and its skull and bones were soft, the skull having that flexible, skin-like character found only in young birds.

"These facts confirm a suspicion which I have entertained for a long time, viz., that Wilson's petrel breeds in winter or early spring in tropical or sub-tropical regions, and visits the coast of the Northeastern United States *only in the interim between one breeding season and the next.* In support of this theory are the following facts: (1) That although the bird literally swarms off our coast during June, July and August, no one has ever found it breeding on the neighboring shores. (2) That the sexual organs of numerous summer specimens which I have dissected have been invariably undeveloped. (3) That a specimen taken June 18, although apparently a young bird, was at least two months old, thus indicating a date of breeding when the species is not to be found in our waters. If the above conclusions prove correct, the case, as far as we now know, will be unique. But there are reasons for suspecting that the same thing obtains with other North American Procellaridæ, especially our two common species of Puffinus."

We are told that the common guillemot (*Lomvia troile*) still breeds at Bird rocks in amazing numbers, but that the number is rapidly decreasing, owing to the introduction of a cannon which is fired every half hour during foggy weather. Mr. Brewster writes: "At each discharge the frightened Murres fly from the rocks in clouds, nearly every sitting bird taking its egg into the air between its thighs and dropping it after flying a few yards. This was repeatedly observed during our visit, and more than once a perfect shower of eggs fell into the water around our boat."—*C. H. M.*

SEEBOHM'S SIBERIA IN ASIA.[1]—Though it is over a year since the appearance of this book, we desire to call attention to it as one of the best recent books of travel. The author is well known as a distinguished ornithologist. This work not only shows his

[1] *Siberia in Asia.*—A visit to the valley of the Yenesay in East Siberia, with description of the natural history, migration of birds, etc. By HENRY SEEBOHM. With map and illustrations. John Murray. 12mo, pp. 298.

talents as an observer, but as a traveler and a narrator. The story is told in an exceedingly interesting way; the illustrations, by Whymper, are dainty, well drawn, and add vastly to the interest and ethnographic value of the book, the author having an eye to the social peculiarities of the Asiatic tribes he met as well as their costumes and weapons.

The work will be of lasting value from the contributions not only to ornithology contained in it, but from the account of the tundras; the breaking up of the ice in the Siberian rivers, and other characteristics of Siberian nature and scenery. The journey was made overland by winter (1877–8), from St. Petersburg to the River Yenesay at Krasnoyarsk, going northward down the river to its tributary, the Koorayika. Mr. Seebohm spent the spring there waiting for the ice to break up and leave the river, so as to release the steamer belonging to his companion, Captain Wiggins, who had planned to take her laden with wheat around through the Arctic sea to England. It may here be said that the steamer was stranded in the Yenesay, and that the two returned overland.

The phenomenon of the breaking up of the Siberian rivers is an exceedingly interesting one. It should be borne in mind that the Yenesay is next in size to the Amazon, being over 3000 miles in length. The ice beginning to break up far northward passes down, choking up the river below, and raising the water in the different tributaries near its mouth, carrying the ice up these streams.

The winter lasted till the first week in June, ice forming each night in May. "On the 1st of June a revolution took place in the ice. There had been scarcely any frost during the night. The wind was south, not very warm, but the sun was unusually hot. As we turned out of the cabin after breakfast, we were just in time to see a small range of mountains suddenly form at the lower angle of the juncture between the Koo-ray-i-ka and the Yen-e-say. The river had risen considerably during the night, and the newly-formed strip of thin ice, on each side of the center ice, was broader than it had ever been. The pressure of the current underneath caused a large field of ice, about a mile long and a third of a mile wide, to break away. About half the mass found a passage down the strip of newly-formed thin ice, leaving open water behind it; the other half rushed headlong on to the steep banks of the river, and, driven on irresistibly by the enormous pressure from behind, it piled itself up into a little range of mountains, fifty or sixty feet high, and picturesque in the extreme. Huge blocks of ice, six feet thick and twenty feet long, in many places stood up perpendicularly. Others were crushed up into fragments like broken glass. The real ice on the river did not appear to have been more than three feet thick, clear as glass, and blue as an Italian sky. Upon the top of this was about four feet

of white ice. This was hard as a rock, and had no doubt been caused by the flooding of the snow when the water rose, and its subsequent freezing. On the top of the white ice was about eighteen inches of clear snow which had evidently never been flooded. Everything remained in *statu quo* during the rest of the day. The river was certainly rising, but slowly. * * * We turned into our berths at half-past nine, having first instituted an anchor-watch in case any further movement of the ice should take place. We had but just fallen asleep when we were suddenly roused by the report that the river was rising rapidly, and the ice beginning to break up. We immediately dressed and went on deck. The position of affairs was at once obvious. The melting of the snow down south was evidently going on rapidly, and the river was rising at such speed that it was beginning to flow up all its tributaries in the north." Getting up steam to be ready for any emergency they found to their dismay that they were squeezed ashore, while the water afterwards fell. "The current was still running up the river, and against it there was no chance of swinging the ship round. A mile astern of us was the edge of the Yen-e-say ice. There was nothing to be done but to wait. In a short time the river began to rise again rapidly, and with it our hopes that we might float and steam into safety, when suddenly we discovered, to our terror, that the ice on the Yen-e-say was breaking up, and that a dread phalanx of ice-floes and pack ice was coming down on us at quick march." How the rudder was smashed, how the "ice-floe began to climb up the ship's side like a snake;" how some of the sailors got overboard, throwing their goods and chattels to their comrades ashore, until finally an immense ice-floe struck the ship, is well told. "At length an immense ice-floe of irresistible weight struck the ship. There was no alternative but to slip the anchor and allow her to drive with the ice. Away we went up the Koo-ray-i-ka, the ice rolling and tumbling and squeezing alongside of us, huge lumps climbing one upon the top of another. We were carried along in this way for about a mile, until we were finally jammed into a slight bay, wedged between blocks of pack-ice. Soon afterwards the river fell some five or six feet, the stream slackened, the ice stood still, and the ship and the pack-ice were aground. * * * The ice remained quiet until about midnight, when an enormous pressure from above came on somewhat suddenly. It had apparently broken up the great field to the north of the Koo-ray-i-ka, but not to an extent sufficient to relieve the whole of the pressure. The water in the Koo-ray-i-ka once more rose rapidly. The immense field of pack-ice began to move up stream at the rate of five or six knots an hour." The stream rose and fell during the day; by noon of the next day, after various vicissitudes to the ship, the water had sunk five or six feet, and the vessel lay on her side, with her bow at least three

feet aground. "These sudden falls in the level of the water were no doubt caused by the breaking up of the ice lower down the river, which dammed it up, until the accumulated pressure from behind became irresistible. Some idea of what this pressure must have been may be realized by the fact that a part of the river a thousand miles long, beginning with a width of two miles, and ending with a width of six miles, covered over with three feet of ice, upon which was lying six feet of snow, was broken up at the rate of a hundred miles a day. Many obstacles would cause a temporary stoppage in the break-up of the ice; a sudden bend in the river, a group of islands or a narrower place where the ice might jam. But the pressure from behind was an ever-increasing one. Although the river frequently fell for a few hours, it was constantly rising on an average, and in ten days the river where we were stationed was seventy feet. Such a display of irresistible power dwarfs Niagara into comparative insignificance. On several occasions we stood on the banks of the river, for hours transfixed with astonishment, staring aghast at icebergs, twenty to thirty feet high, driven down the river at a speed of from ten to twenty miles an hour. The battle of the Yen-e-say raged for about a fortnight, during which the Koo-ray-i-ka alternately rose and fell. Thousands of acres of ice were marched around up stream for some hours, then the tide turned, and they were marched back again. This great annual battle between summer and winter is the great event of the year in these regions, like the rising of the Nile in Egypt. * * * This sudden change in the short space of a fortnight, from mid-winter to mid-summer, can scarcely, by courtesy, be called spring. It is a revolution of nature, and on a scale so imposing, that the most prosaic of observers cannot witness it without feeling its sublimity."

The ice was still straggling down stream, while the country was flooded for miles on each side of the river; hundreds of acres of ice had drifted into the forests, and when the water subsided frozen blocks would probably be stranded among the trees, and gradually melt on the ground a few days later. "It was astonishing to see the quantity of wood that was floating down, but as we coasted the shore to avoid the current, we easily saw whence it all came. In many cases the banks were undermined for six or eight feet; in some places they had fallen in, and the trees growing upon them were hanging down in the water. The banks are nothing but sand and earth; the river evidently widens every year, and carries an immense quantity of mud down to its mouth."

Among modern travelers Nordenskiöld has given us considerable information regarding the tundras, but he only saw it from the seashore. Here are two pictures of these vast flat lowlands of the treeless portions of Siberia. "I went ashore in the morning to ascertain what bird-life was to be found on the tundra. We climbed up the steep bank, and found ourselves in a wild-looking

country full of lakes, swamps, and rivers, a dead flat in some places, in others undulating, even hilly. This was the true Siberian tundra, brilliant with flowers, swarming with mosquitos, and full of birds. In sheltered places, dwarf willows and weeping birch were growing, and (we were only some fifty versts from the forests) here and there a few stunted larches. Winding through the tundra was the track of what had once been the bed of a river, nothing now but a small deep valley forming a chain of isolated lakes and pools. * * * On some of the northern slopes, large patches of snow were still lying."

"The history of animal and vegetable life on the tundra is a very curious one. For eight months out of the twelve every trace of vegetable life is completely hidden under a blanket, six feet thick, of snow, which effectually covers every plant and bush—trees there are none to hide. During six months of this time at least, animal life is only traceable by the footprints of a reindeer or a fox on the snow, or by the occasional appearance of a raven or a snowy owl, wandering above the limits of forest growth, where it has retired for the winter. * * * Then comes the south wind, and often rain, and the great event of the year takes place; the ice in the great rivers breaks up, and the blanket of snow melts away. The black earth absorbs the heat of the never-setting sun; quietly but swiftly vegetable life awakes from its long sleep, and for three months a hot summer produces a brilliant alpine flora, like an English flower garden run wild, and a profusion of alpine fruit, diversified only by storms from the north, which sometimes for a day or two bring cold and rain down from the Arctic ice.

That the tundra is the former bottom of the Arctic ocean seems to us to be proved by the shallowness of the Arctic sea north of Siberia as shown by Nordenskiöld's map, also by the presence of hills of shells found by Seebohm, at least 500 feet above the sea, belonging to species still living in the Arctic ocean, the fossils occurring near or in a bluish, sandy clay. Space is not left us to speak of Seebohm's discoveries regarding the migrations of birds in Siberia, and the new facts he discovered regarding their hybridity and nesting habits. The volume will supplement Nordenskiöld's narrative.

WINCHELL'S WORLD-LIFE.[1]—The mode of formation, growth and decay of the worlds that people the universe is the loftiest theme upon which the human mind can exercise itself, but from its very loftiness is one upon which, as Professor Winchell would himself be one of the first to admit, certain knowledge has not yet been attained. When rival theories dispute for precedence, or

[1] *World-Life or Comparative Geology.* By ALEXANDER WINCHELL, LL.D., Professor of Geology and Palæontology in the University of Michigan. Chicago, S. C. Griggs & Co., 1883.

when a generally accepted theory has been weakened by the presentation of an array of objections, he does much for science who shows that these objections, valid perhaps against the first crude form of a theory, do not really invalidate it, though they may render necessary some modification and addition. This is precisely what Professor Winchell performs, in this ably written volume, for the well-known nebular theory of Laplace, which has of late years been attacked by a series of objections, such as the existence of retrograde motions; the length of the periodic times of the planets, which have been stated to be in some cases longer, in others shorter than the nebular theory allows; the absence of an adequate cause for rotary motion; the want of coincidence in the planes of the planetary orbits, their ellipticity, and their distances from each other. To these objections are added others based upon the relations of the planetary masses and densities; the geologist's objection that his science shows that more time than the nebular theory allows has been occupied by the earth in arriving at its present condition; and various others based on the relations of comets, stars and nebulæ.

Without disputing that these objections are fatal to the idea of nebulous matter contracting into rings, and ultimately into worlds without the intervention of any disturbing force, Professor Winchell seeks to modify the theory by finding the resisting force which, though it permitted the phenomena of the solar system to accord as a whole with the requirements of Laplace's theory, yet induced numerous deviations and eccentricities. The hypothesis of a regularly distributed ethereal medium is evidently insufficient, but the existence of cosmical dust, unevenly distributed, since it is in numberless positions tending towards aggregation, is by our author believed to furnish a cause for the observed deviations from regularity.

The first chapter treats of this cosmical dust, or meteors, the zodiacal light, comets, the Saturnian rings, and nebulæ of various kinds. The universe is supposed to be everywhere pervaded with the crude material out of which worlds are formed, and the ideas of Newton, Humboldt, Williams, and Siemens are reviewed. Then follows the theory that swarms of small masses of dark matter, circling in numberless orbits, and in all directions about the principal bodies of the solar system, but especially about the sun, must be in frequent collision with the planetary bodies, and must thus accelerate their motions and shorten their periods. This idea of cosmical matter (not ether) as a resisting medium, accounting for the eccentricities of planetary orbits, the want of coincidence between the planes ofthe equators of the planets, and between the orbit and equator of the same planet, for acceleration, and for irregularities in the movement of comets, is claimed by Professor Winchell as not yet trite, if not entirely new. The work embraces numerous other novel suggestions which bridge over

difficulties that others have magnified. At pages 111–113, reasons are given why, in a contracting, rotary spheroid, "an annular mass of relatively considerable amount would separate, and a secular interval would intervene before the separation of another annular mass." This ring would be completed when the centrifugal force at the equator exceeded the centrifugal force plus the attractions of the separated ring. At page 121–3 the causes of the rotation of the mass derived from a ring, and those which influence its direction, are treated of. In treating of the general cosmogonic conditions of a cooling planet Professor Winchell appears to coincide with the theory which would make the center of the earth solid; he gives reasons why "sub-meridional trends" should be early established upon a cooling globe, so that all the *primitive* wrinklings of the crust should extend across its parallels; explains the craters of the moon by the tidal outflow of molten matter; and gives reasons for believing that planetary tides cause the development of much heat. The floor of the primitive ocean had, says our authority, an igneous origin, but it no longer exists on this earth, having been destroyed by sedimentation from above, and by fusion from below. Professor Winchell supports the older theory of a shrinking globe and a wrinkling crust, against the objections of LeConte, Dutton, Fisher, and others.

The present condition and cosmogonic history of the planets are next treated of, commencing with the earth. It is here suggested that "the tidal deformations of the earth's crust may be the source of the internal heat which manifests itself in fluidity," and farther on Professor Winchell considers the probable effect of tidal action upon other planets. Mars is said to have lost all water and atmosphere; Venus to have a planetary history not greatly divergent from that of the earth, and probably an atmosphere admitting light aud heat to about an equal extent with that of the earth; and Jupiter to be still lingering in the high thermal stages of planetary life. The next chapter treats of planetary decay, of the final disappearance of the continents beneath the ocean by the operation of erosion and the cessation of elevatory forces, and of ultimate planetary death from refrigeration and other causes. In the third part the systems outside of our own are dealt with. Eruptive action on an incrusted globe is spoken of as the most probable cause of variable and temporary stars. In the last part the speculations of the great philosophers, of Kepler, Descartes, Leibnitz, Swedenborg, Wright, Kant, Sir W. Herschel, Laplace, are brought together and compared. It is shown that the conceptions of unorganized homogeneous matter (chaos), and of a vortical movement existed from the dawn of Greek philosophy, but that the dynamical principles of the solar system were settled by Newton and the great mathematicians of the eighteenth century, while the etailed theory of world-formation is principally due to

Laplace and Kant. The book is written by an earnest thinker for the use of earnest thinkers, by whom, even if not in all points agreed with, it will be held in high esteem.

DOBSON'S MONOGRAPH OF THE INSECTIVORA.[1]—The well known and able author of a "Natural History of the Chiroptera" has in this monograph, two of the three parts of which are now issued, extended his labors to the more complicated group of the Insectivora. His classification is, ostensibly, founded upon Peters, Mivart, and Gill, and recognizes two sub-orders, one of which (Dermoptera) contains the flying lemur or Galeopithecus, while the other (Bestiæ), includes all other insectivores. The Bestiæ are ranged in two groups and five super-families, viz: Tupaioidea, Erinaceoidea, Soricoidea, Centetoidea, and Chrysochloridea. The Tupaiidæ and Macroscelidæ are ranged in the first super-family; the Talpidæ and Soricidæ in the third; the Centetidæ, Solenodontidæ and Mythomyidæ in the fourth. The other super-families contain but a single family each. The Erinaceidæ are selected to commence the study of the order, on account of the fact that they afford the largest species to be found in the first three super-families which form the first group, and are characterized by molars with broad W-shaped crowns. The Centetidæ, equally typical of the second group with V-shaped molar crowns, and also of large size, follow the true hedgehogs. Two species of Gymnura are recognized, viz: *rafflesii* and *suilla*, the latter differing mainly in the shortness of the tail, and in its smaller size. Of Erinaceus nineteen species are enumerated, nine of which are African, while all the others occur in Asia, and one only in the Palæarctic region in both Europe and Asia. The six genera of Centetidæ contain but eight species, all Madagascan, though *Centetes ecaudatus* is found also in the Comoro islands, and also in Bourbon and Mauritius, in which islands it has probably been introduced. The sub-family Oryzorictinæ contains only *Oryzorictes hova*, a species at present known by two specimens in the Paris Museum. Microgale with two species, and Geogale with one, are recent additions to the Centetidæ. Although *Solenodon cubanus* is enumerated as distinct from *S. paradoxus*, it is allowed to be so closely allied that additional material may prove it a local variety. Nothing is known of the habits of this genus in its wild state. *Mythomys velox* is still the sole and little known example of its family, which differs from Centetidæ and Solenodontidæ in the absence of clavicles, and has the crowns of the molar teeth intermediate between the V-shaped ones of these families and the W-shaped ones of Talpidæ. From its large, laterally flattened fish-like tail, it is evidently a good swimmer, as stated by Du Chaillu.

[1] *A Monograph of the Insectivora, Systematic and Anatomical.* By G. E. Dobson, M. A., F. R. S. Parts I and II. London, J. Van Voorst, 1882–83.

The Chrysochloridæ include only the five species of the typical genus, and are limited to Africa south of the Equator. Although formed for digging, the modifications of the body and limbs for this purpose are quite different from those of the Talpidæ, since the former have long clavicles and a hollowed-out thorax instead of short clavicles and a lengthened manubrium.

The family Talpidæ includes twelve genera and eighteen species and has a wide distribution in the Palæarctic, Nearctic and northern part of the Oriental regions. Though most are fossorial, some (Myogale) are natatorial, or (Uropsilus) cursorial, but all agree in the remarkable peculiarity of a double articulation of the humerus with the scapula and clavicle. The incisors, canines and premolars vary extremely in form, but the molars are uniform in number ($\frac{3-3}{3-3}$), and nearly so in shape. The fossorial habits of the Talpidæ are correlated, in the fore-limbs, with an elongated manubrium and small quadrate clavicles, and, in the hinder, by an inward curvature of the os innominata. This is carried to such an extent in some species (*Mogera wogura*, e. g.) that the bones meet between the acetabula. The genera are distinguished principally by the teeth.

The anatomy of Gymnura, Erinaceus, the Centetidæ, Solenodon, Mythomys Chrysochlora, Myogale and the typical moles, is given in detail, with special attention to the myology, a department too much neglected in the majority of monographs. The two parts are illustrated with twenty-two well executed plates, thirteen of which are colored, and are principally designed to illustrate the muscular system.

Coues' Key to North American Birds.[1]—When the reviewer finds himself face to face with the completed work of an acknowledged master, with a work which embodies the results of a lifetime of discovery, observation and research, it seems superfluous to praise, and envious to criticise. The only course left is to succinctly describe the contents, and, in this case, to compare with the older Key, of which the present is an amplification. The original volume, published in October, 1872, formed an imperial octavo of 361 pages, illustrated with 238 wood-cuts and six steel plates. The present volume contains 863 pages, besides thirty in the historical preface, and is illustrated with 561 wood-cuts. The species, including binomials and trinomials, are 878 in number. The work consists of four parts. Part I contains, with some little amplification, the matter originally published separately under the title of "Field Ornithology," and is a manual of instruction for collecting, preparing and preserving birds. Invaluable as the advice of one whose life has been largely occupied in the pro-

[1] Key to North American Birds, containing a concise account of every living and fossil bird at present known from the continent north of the Mexican and United States boundary, inclusive of Greenland. By Elliott Coues, M.A., M.D., Ph.D. Boston: Estes & Laureat, 1884.

cesses he describes, it is rendered still more so by the clearness and simplicity of the directions, and by the thoroughly sensible hygienic advice accompanying it. Part II consists of the introductory matter of the old Key, very greatly amplified, and forms a kind of "Closet Ornithology" as distinguished from a "Field Ornithology." In it are explained the technical terms in use among ornithologists; and the structure of the external and internal parts, including nerves, muscles, lungs and lung-sacs, and digestive organs, as well as osteology, is extensively entered into. This part contains also a treatise on oölogy, and concludes with artificial keys to the orders and families, and a tabular view of the classification. Part III, the main body of the work, describes all the species and subspecies of North American birds at present known, defines the genera, and characterizes the families and higher groups. The descriptions are much more elaborate than those of the old Key, but the amplification has been made solely with the aim of facilitating the identification of specimens. Although some descriptions are taken from the author's Birds of the Colorado Valley, Birds of the Northwest, etc., by far the greater part of the matter here contained is new. Scarcely any of the older work is left unaltered. The references to authorities, which, in the old Key, closed the descriptive paragraphs, are omitted, and the space thus gained is utilized for references to the nest and eggs, song, flight, migratory or other habits of the species, so as to epitomize the life-history. Geographical distribution is prominently and thoroughly treated, and considerable attention has been paid to descriptions of the plumage of females and of young birds. The specific names are marked for accent. Part IV is short, but is a valuable synopsis of the known fossil birds of North America, forty-six species in all.

Many of the engravings of the former edition have been discarded and replaced by better. About fifty are from Brehm's Thierleben, near as many more from Dixon's Rural Bird Life, a few from the Proceedings of the Zoölogical Society of London, and from D. G. Elliot's Birds of America, about fifty from drawings by Mr. Edwin Shepherd, and many from those made by the author. About thirty anatomical drawings were furnished by Dr. R. W. Shufeldt, and Mr. R. Ridgway and Mr. H. W. Elliot have given others.—*W. N. L.*

Manual of the Mosses of North America.[1]—For many years those botanists who have not been content to study flowering plants alone have been looking for a good manual of the mosses of the country. The little work by Sullivant which was bound in with one of the editions of Gray's Manual had long since not only gone out of print and become difficult to procure.

[1] *Manual of the Mosses of North America.* By Leo Lesquereux and Thomas P. James, with six plates illustrating the Genera. Boston: S. E. Cassino & Company. 1884. 8vo, pp. VI, 447, 6 pl.

but it had also become largely obsolete. When, therefore, it became understood some years ago that Sullivant and Lesquereux were at work on such a manual, there was an expression of general satisfaction. But Sullivant passed away, and his colleague was stricken with partial blindness. After an interval the work was resumed by Lesquereux, aided by Thomas P. James; but two years ago death again left the former to go on alone. Again the aged worker sought a helper, and found it in Mr. Watson of the Harvard Botanic Gardens, with whose assistance the present volume has been brought out.

We have examined it with much care, and have been pleased throughout. The treatment appears to us to be quite satisfactory, the descriptions being unusually full and clear. The keys are ample and well arranged, and these, with the plates (five from the old work of Sullivant), will enable almost any one to determine the classification of any moss.

The mosses are here considered to constitute a class including three orders, viz: Sphagnaceæ (the peat-mosses), Andreæaceæ (the schizocarpous mosses) and Bryaceæ (the true mosses). The Phascaceæ are considered as forming a tribe (the lowest) of the Bryaceæ. This is, in our opinion, an error. Their indehiscent capsules and minute size ought to entitle them to ordinal rank as much as the Andreæaceæ. Bryaceæ, moreover, are arranged in three series, viz: Acrocarpi, Cladocarpi and Pleurocarpi, and these include, all told, twenty-three tribes. The last of these tribes, Hypneæ, includes the single genus Hypnum, which is represented by 195 species distributed among twerty-eight subgenera. There are, all told, about 900 species of mosses described in this manual, which is more than double the number treated in Sullivant's little work. In the words of the surviving author it "is believed to include descriptions of all the species of mosses that are as yet known to occur in the North American continent within the limits of the United States and northward." —*C. E. B.*

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—*Results of the Greely Expedition.*—On May 13th, 1883, Lieut. Lockwood and Sergt. Brainard reached an island which has been named after the former (lat. 83° 24′ 30″ N., long. 44° 45′ W). From an elevation of 2000 feet no land was seen to the north or north-west, but Cape Robert Lincoln in Greenland (lat. 83° 35′, long. 38°), was seen to the north-east. Animal life was found to be abundant, with scanty vegetation, like that of Grinnell land. Traces of hares, lemmings, bear, musk-ox, ptarmigan and snow-bunting were seen. The party was absent fifty-nine days. The latitude attained on this occasion was four miles farther north than the highest reached by the English. In another journey Lockwood and Brainard crossed Grinnell land, and from its western coast looked out on the Polar sea. The southern part of this land is covered with an immense glacier, which they named the Agassiz glacier. Sixty miles of land intervene between this and the northern ice-cap. While resting three days ninety miles from Beatrix bay, at the head of Archer fiord, they struck the head of a fiord from the western sea. This they named Greely fiord. From its center, in latitude 80° 39″, and longitude 78° 30′, they saw from the summit of a cliff, 2200 feet high, the northern shore terminate in a high headland, which they named Cape Brainard. To the south, some seventy miles distant, was Cape Lockwood, apparently upon a land which, as open water intervened, they thought to be separate from Grinnell land, and named Arthur land. In 1882 Dr. Pavy followed the Markham route, and was adrift in the Polar sea north of Cape Joseph Henry. Abandoning everything, he escaped to land. In 1883 Lieut. Lockwood was turned back by open water on the North Greenland shore. In 1882 Lieut. Greely made two trips into the interior of Grinnell land, and discovered Lake Hazen, some sixty miles long by ten wide. This large body of fresh-water is fed by the ice-caps of North Grinnell land, and discharges by Ruggles river into Weyprecht fiord, and thence into Conybeare bay and Archer fiord. From the summit of Mount Arthur (5000 feet) the contour of

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

the land west of the Conger mountains convinced Lieut. Greely that Grinnell land tends directly south from Lieut. Aldrich's farthest in 1876. Ruggles river was open at its mouth in April. Winter quarters of Eskimo were found, and some relics showing that they had possessed dogs, sleds and iron. Mount Arthur is the highest point in Grinnell land, which has two ranges of mountains, the Conger and Garfield ranges, parallel to and beyond the United States range. Hares, birds, and musk-oxen were seen in plenty on this journey. In March of this year Sergeant Long, while hunting, looked from the north-west side of Mount Carey to Hayes' sound, and saw on the northern coast three capes to the westward of the farthest seen by Nares in 1876. This sound extends twenty miles farther west than is shown by the English chart, but is possibly shut in by land, which showed up across the western end.

Geysers of the Yellowstone.—*Science* tells us that a comparison of the thermal activity of the geysers in Yellowstone in 1878, with that displayed on previous years, is adverse to the theory of diminution in intensity. Mr. A. Hague reports an additional geyser in the Fire-hole basin, and another in the upper geyser basin. The first, situated on the broad inter terrace north-west of the mounds of the Fountain geyser, has a pool 90 to 100 feet across. The vent is near the west border, and throws up at its first burst a column of water eight feet in diameter and twenty-five or thirty feet high. There is apparently a second vent of lesser power. Dr. Peale, in 1878, suggested that this might be a geyser. It is named the Surprise. The new geyser in the Upper Basin is Spring No. 9 of the Emerald group, and throws the water to a height of from thirty to fifty feet. This is called the Cliff geyser.

AFRICA.—*The Bahr-el-Ghazal.*—Letters from Lupton Bey dated November 5th and 6th, 1883, proves that up to that date he was alive and well, and actively engaged in fighting El Mahdi. Although these operations, with the impossibility of communication with Khartoum, have greatly hindered geographical exploration, Mr. Lupton has transmitted a sketch of his routes, and some valuable determinations of latitude, height, etc.

The river Kuta, which at Barusso (about 22° 50 E. long., and 5° 15 N. lat.) is from two to three miles broad, is formed by the junction of the Welle and the Mbomo. These two large rivers the headwaters of the affluents of which rise close to those of the tributaries of the Bahr-el-Ghazal, and water the Niam-niam and Mangbutta countries, unite at Mabele, about thirteen hours march east of Barusso, and the Kuta is shown on the sketch map as flowing westward from the point of junction. Mr. Lupton opposes the theory that the Kuta is the Shary, from the fact that the latter river is only half a mile wide where

flows into Lake Chad. The rivers Pango, Kuru and Biri do not flow into the Bahr-el-Arab, as marked on Dr. Schweinfurth's map, but into the Bahr-el-Jur, which, joining the Bahr-el-Arab, a little east of 29° W. long. and a little north of 29° N. lat. forms with it the Bahr-el-Ghazal. It appears that the death of the Dutch traveler, Mr. Schuver, was the penalty for his own rashness. The Nazir of Meshra, knowing that the hostile Denka blocked the road, wished to detain him, but he insisted on the right to free travel given him by the governor-general, and started for Jur Ghattas. The next day he and his party were killed by the Janghe or Denka. The tribes that have revolted are the Denka, Nuer, Dembo, and Mandala, who are mixed up with the Arabs.

The French on the Congo.—M. Dutreuil de Rhins, the representative in France of the French "mission" in West Africa, states that surveys have been made for 800 kilometers up the Ogowé, and thence from Franceville to the Alima. At the station of Alima-Leketi, work is progressing upon stone houses and sheds in which boats for the navigation of the Congo will be built. The Nconi, the Luete, and the Quillu have also been explored; and numerous journeys made in before unknown regions. The treaty concluded with the International Association has removed some of the greatest difficulties.

The Upper Congo.—Messrs. Bohm and Reichardt continuing their route after the death of Dr. Kaiser, November 19, 1882, have founded the station of Mpala. A map of the region between Tabora and Tanganyika has been made by M. R. Kiepert from the notes of Dr. Kaiser. The same geographer has mapped the route of Lieut. Wissman. On this map many positions and heights are carefully calculated, and the southern part of the Congo basin is shown to be a grand plateau, from which rise elevations of from 100 to 200 meters, forming the water-parting between the affluents of the great river.

Asia.—*The Amu-Daria or Oxus.*—The Uzboi, the old bed of the Oxus, has been recently explored by General Glukhovskoi and his assistants. From a paper read by M. Sviridoff at St. Petersburg it appears that the Oxus is as large as the Volga at Simbirsk, and is navigable for more than 1000 miles. Its waters are charged with sediment, and its overflow causes the fertility of the Khivan oasis. At the same time its floods cause great damage in its lower course, particularly in its delta. In 1880 several towns were half destroyed. On the frontiers of the Khivan khanate the Daudan and Kunia-Daria are detached from the Oxus. The first is not perceptible at its commencement, which is covered by cultivated ground, but about sixteen miles from the main river it comes into sight, being filled with water from the canals of the Khanate. After a course of ninety miles, the Daudan is swallowed up by sand, but after crossing the Shamrat canal, it again

becomes a regular water-course and persists as far as the Sarikamish basin. Dry side canals, with traces of past cultivation, exist on the banks of the Daudan. The Kunia-Daria leaves the Amu Daria as a small water-course, winding in the broad hollows of the old channel, and extending as far as the dam of Kizil-Tokar. Beyond this stretches a dry water-course, but at the town of Kunia-Urgenj it again becomes a river, and is called the Urun-Daria. Dams for irrigation exist on this river. When the Amu-Daria is high it frequently overflows into the Karia and Urun-Darias. In 1878 the water thus poured into this channel raised the lakes of Sarikamish twenty-eight feet. South of the lakes of Sarikamish a broad flat valley is formed out of the saline marshes, and farther on this assumes the character of a river-bed. This is the Uzboi—the old course of the Amu-Daria. Deposits of a former river, masses of earth washed down by it, decayed roots and weeds on its banks, ruins of an aqueduct and other buildings, combine with its regular banks to prove it the former water way. M. Sviridoff concluded by stating his belief in the possibility of deflecting the Amu-Daria into its old bed, via the Uzboi, to the Caspian.

Mr. Carles's Journey in Corea.—Mr. Carles reports that Chimulpho, the port of Jenchuan, is rapidly building up. The Han river, distant twenty-four miles from Chimulpho, is navigable for junks of 100 tons to Mapu, the port of Soul. Mapu extends for some miles along the northern bank of the river, and is four miles from Soul. Soul, a city three miles long by half that width, is enclosed by massive walls of stone, twenty-five feet high, with two-story towers. The houses are of one story, built of wooden pillars which support a thatched roof. The spaces between the pillars are filled in with mud walls, which in the better class of houses are faced with stones, tied together with millet stalks and pointed with cement. The houses contain but little furniture, but are cleaner and warmer than those of Northern China. There is a marked absence of color in streets and houses.

In the north-east and north of Corea the country is well-wooded and watered, and fine timber is brought down the Ya-lu and exported to China. The highest peaks of the backbone of Corea seem to be to the south-east. The light porous soil of the valleys is highly cultivated, but the mountains north of Soul are strikingly barren. It seems to be impossible to purchase anything in Corea except during a fair. Mr. Carles says that the people everywhere have plenty of food, firewood, and cotton clothes, of which they wear strikingly little, with substantial mud-dwellings; beggars are rare, and the working classes are better off than in China; but great riches are uncommon. The women are kept in marvelous seclusion.

Arabia Petræa.—Mr. Hull has completed his journey through Wady-el-Arabah, the entire length of which he was not able to

traverse on account of the hostility of the Bedouins. From the lines of now abandoned beach which he has discovered at a height of sixty meters in the Gulfs of Suez and of Akabah, Mr. Hull believes that a communication existed between the Red sea and the Mediterranean in the time of the Exodus. He also believes that the level of the Dead sea was formerly 425 meters higher than it now is.

EUROPE.—The three provinces which have been added to Greece by the treaty of Berlin have at last an organized administration. They are named, after their chief places, Trikkala, Larissa, and Arta, but the two former are properly Upper and Lower Thessaly, and the last is a small portion of Epirus. Trikkala has 117,229 inhabitants; Larissa, 144,621, and Arta only 31,178.

Australia.—Mr. Lindsay's explorations in Arnheim land, northwest of the Gulf of Carpenteria, have resulted in the discovery of much good land, and of some new rivers. Following the coast northwards from the Roper, a river called Parsons or Rose was found, with good ground at its head. The Walker, a river not indicated in the survey map of 1880, was followed for forty miles through a mountainous and beautiful country. Across the water-parting from this river, another fine river was reached, and was followed until it was found to be the Goyder, the mouth of which was all that was before known. The district around this river is fitted for grazing, agriculture or sugar-growing. The Blythe is another fine river, but the Liverpool, which looms large on the chart, does not run at twenty-miles from the sea. The party had much difficulty with the natives, who speared four horses, and suffered much from want of water on the Liverpool, and in other places between the rivers.

GEOGRAPHICAL NOTES.—Mr. E. G. Ravenstein has contributed to the Proceedings of the Royal Geographical Society a résumé of all that is known respecting Somal and Galla land, embodying information collected by the Rev. Thos. Wakefield.——Mr. A. M. Mackay has undertaken a boat voyage from Uganda to Kagege, along the western shore of Lake Victoria Nyanza, and has explored Jordan's Nullah, the position of which is erroneously marked on all published maps. He believes that the height of the lake given by Stanley (3800 feet) is 300 feet too much.——Mr. Selons has recently explored a tract of elevated country lying near the headwaters of the Sabi, and between the Manyame and the Hazœ, tributaries of the Zambesi. This region is a dome-like plateau saturated with springs which form the sources of the neighboring rivers, and seems to be the highest land in south-eastern Africa. The wind is sharp and cold, droughts and famines are unknown, and the natives get abundant and diversified crops. Mr. Selons thinks it well adapted for European occupation.——M. Giraud has been compelled to retreat to

Karema on account of the hostility of the natives. He descended the Luapula for some distance, and found that, as shown in Ravenstein's map of Eastern Equatorial Africa, this river flows out of the south-west side of Lake Bangweolo.——Dr. Pogge died at St. Paolo de Loanda on March 17th.——The bay of Angra Pequeña, 27° N. lat., on the coast of Great Namaqua land, has recently been taken possession of by Germany. It is curious that upon the maps, even on those of the Germans themselves, this spot is marked as belonging to England.——Robert Flegel continues his explorations of the Niger and the Benua. While waiting for funds, he joined the Swiss explorer, Zweifel, in a voyage upon the lower course of the Niger. This exploration has given us a map of the Niger and its affluent the Amambara. On his return to the coast M. Flegel found himself able to continue his work, and reached Loko on September 11th.

GEOLOGY AND PALÆONTOLOGY.

OBSERVATIONS ON THE PHYLOGENY OF THE ARTIODACTYLA DERIVED FROM AMERICAN FOSSILS.[1]—I have maintained[2] that the Selenodont dentition is a derivation of the bunodont, a proposition which seems unavoidable from a mechanical point of view. The testimony of palæontology is also in its favor since in America the oldest Artiodactyle, Pantolestes, is Bunodont. Kowalevsky, in the phylogenetic table given in his monograph of Anthracotherium[3] does not commit himself as to this point, but allows the development of the two types of dentition to appear to have been contemporary and from some common origin. He then derives from such a common point of departure, first, the Hyopotamidæ, which first appeared in the Eocene, and second, the ancestors of Anoplotheriidæ. From the Hyopotamidæ he derives all the modern Selenodonta, exclusive of the Camelidæ. The latter group he omits from his table, doubtless because his information on the subject was insufficient. The main line of origin of the Selenodonta is divided early in the Miocene time, the genus Gelocus giving origin to the Pecora, and the genus Hyæmoschus to the Tragulina.

In describing the characters of the genus Poëbrotherium for the first time, I remarked as follows:[4] "The present genus is a more generalized type than Gelocus, and in its distinct trapezoid and distinct metacarpals represents an early stage in the developmental history of that genus. It also presents affinity to an earlier type than the Tragulidæ which sometimes have the divided metacarpals, but the trapezoïdes and magnum coössified. In fact Poëbrotherium as direct ancestor of the camels, indicates that the

[1] Portion of a paper read before the Amer. Asso'n Adv. Science, Phila., 1884.
[2] Journal Academy Nat. Sciences, Phila., 1874.
[3] 1873 (? 4), p. 152.
[4] Bulletin U. S. Geol. Surv. Terrs., Vol. I, No. 1, p. 16, Jan., 1874.

existing Ruminantia were derived from three lines represented by the genera Gelocus, for the typical forms, Poëbrotherium for the camels, and Hyæmoschus for the Tragulidæ."

These views being then established on sufficient evidence, it remains to make such additions as the facts cited in the first part of this paper indicate. First in importance comes the place in the phylogeny of the Selenodonta, of the Oreodontidæ. The peculiar inward extension of the unciform bone already ascribed to them, characterizes also among extinct forms the genus Leptomeryx, and probably Hypertragulus. Among recent ruminants it is only seen in the Tragulidæ.[1] If we arrange these types in serial order we find the modifications of forms to be generally identical with those of the other ruminant lines, in the coössification of the bones of the legs and feet. This series may then be regarded as phylogenetic. The peculiar structure of the carpus of the Oreodontidæ puts them out of the question as ancestors of any type of existing ruminants other than the Tragulina. Whether they themselves can be traced to a five-lobed, or to a four-lobed bunodont ancestor, remains an undecided question. It is not, however, probable that a five-lobed form has been intercalated in a series, both of whose extremities are four-lobed. If this be true, the Oreodontidæ must be regarded as an ancestral type of Selenodonta, coëqual with the Hyopotamidæ, and it may well be questioned whether the latter can have been ancestors of the existing Ruminantia, whose molars are four-lobed.

So the present investigation does not disclose the ancestral stock of the Pecora. In North America we have not progressed further in the solution of this question than I reached in 1877,[2] after a study of the genera Cosoryx Leidy, and Blastomeryx Cope. I had already[3] suggested that the former genus is the ancestor of the Cervidæ, but subsequently[4] remarked "it is not probable that this genus is the immediate ancestor of Cervus, from the fact that the molar teeth display in their prismatic form a higher degree of specialization than belongs to that genus. It is probable that the true ancestor combined the dental type of Cervus with the distinct roots and short crowns of the molars, with the type of horns here described." I at that time included a species (*Cosoryx gemmifer* Cope), in the genus provisionally, which has the type of molars in question. Having discovered another larger species which has the same type of molars, I at once distinguished the provisional group in which I had placed the *C. gemmifer*, Blastomeryx, as a genus, and in describing the species (*B. borealis*) observed as follows: "In brief, its molars differ from those

[1] Among Perissodactyles it occurs in Tapirus and the Rhinocerontidæ.

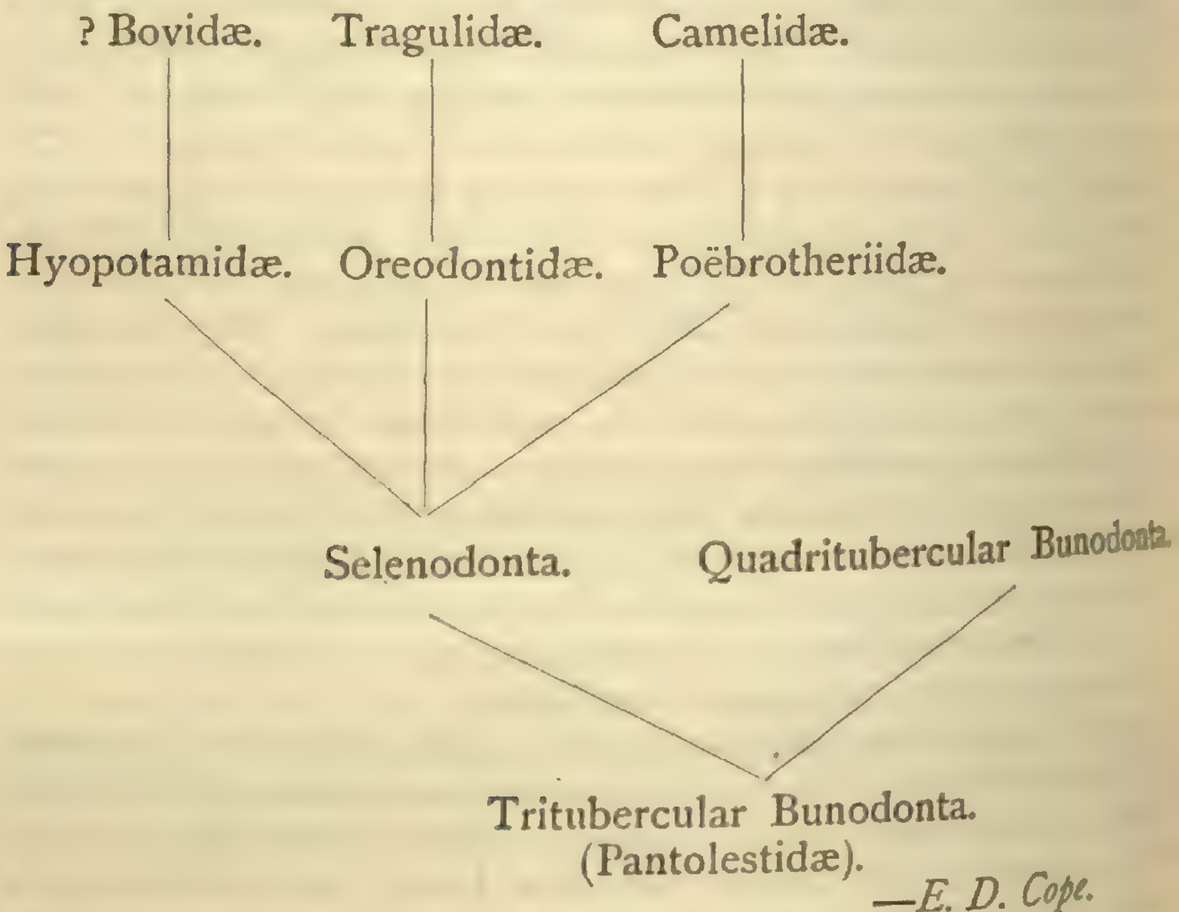
[2] Proceedings Amer. Philos. Soc., p. 223.

[3] Proceed. Acad. Phil., 1874, p. 149.

[4] Report Expl. and Surv. W. of 100th Merid. U. S., Geo. M. Wheeler in charge, IV, pl. II, p. 349, 1877.

of Cosoryx ("Dicrocerus") as much as those of the deer differ from the molars of the antelope. While Cosoryx ("Dicrocerus") was probably the ancestor of Antilocapra, Blastomeryx was the ancestor of Cervus or Cariacus." This opinion expresses all the information I possess on the subject at present. It remains to ascertain the structure of the anterior feet in Hypisodus, which is the earliest genus of Ruminantia known to have prismatic molars.

The following table will represent the views expressed in the preceding pages:



—*E. D. Cope.*

ERUPTION OF KRAKATOA.—It will be remembered, says *Science Gossip*, that the Dutch government appointed a commission to investigate the nature and results of the eruption of Krakatoa, in August last. The report has just been presented by Dr. Verbeck, and it is a remarkable illustration of scientific courage and adventure. At the same time it shows that the eruption was on a scale which might almost be called catastrophic. Krakatoa lies on a rent or fissure in the crust of the earth which runs across the Straits of Sunda. Dr. Verbeck thinks that sea-water may have been admitted thus to the molten matter beneath, so as to form steam at high pressure. The sound of the volcanic explosion of August last was heard over a space equal to one-sixth of the earth's circumference. So violent were the air waves caused by the explosion, that walls were rent by them (not by earthquakes) at the distance of 830 kilometers away. One air-wave was propelled from Krakatoa which traveled no less than three and a quarter times round the circumference of the earth. The large tidal wave appears to have been caused by the northern

part of the mountain giving way. There only remains the southern part, which has been cut in two from the very top, and forms on the north side a magnificent precipitous cliff more than 2500 feet high. In the place where the fallen part once stood there is now everywhere deep sea, in some places as much as 1000 feet deep. The ashes thrown out by the eruption must have been enormous, especially if we are correct in assuming that the brilliant sunsets are due to the finer parts suspended in the atmosphere. Within a circle of fifteen kilometers' radius from the mountain, the layers of volcanic ashes thus ejected cover the ground from sixty to eighty meters thick. The known surface over which the ashes were ejected, as calculated by Dr. Verbeck, is 750,000 square kilometers, apart from other unknown areas where they also descended. He thinks that the finer particles, propelled by the wind, have made a journey round the world. The vapor was condensed to water, and froze in the cold currents. The refraction through these innumerable ice crystals, Dr. Verbeck thinks, caused the beautiful and red glows of our phenomenal sunsets. He calculates that the quantity of solid substances ejected by the volcano was eighteen cubic kilometers. Dr. Verbeck and his staff thoroughly explored the island last October, when the heat was so great as almost to stifle them.

The Seventh Volume of the Geological Survey of Illinois commences with a description of the coal measures by A. H. Worthen. The coal fields occupy 3600 square miles, and contain sixteen seams, five of which can be profitably mined at some points. At a depth of 682 feet a deposit of coal oil has been found at Litchfield. Messrs. Orestes St. John and A. H. Worthen contribute descriptions of the carboniferous fossil fishes. As many as sixty-three Cochliodontidæ are described, of which some fifty-seven are new, comprising the new genera Vaticinodus, Stenopterodus, Chitonodus, Deltodopsis, and Orthopleurodus. Thirteen species of Psammodontidæ are characterized, eleven of which are new. The teeth of the Psammodontidæ form a pavement akin to that of Myliobates, but each tooth is quadrangular or trapezoidal. Ichthyorodulites conjectured to belong to twenty-two forms, mostly new, are also described. The volume concludes with descriptions of the carboniferous invertebrates, by A. H. Worthen, S. A. Miller and others. Thirty-seven species of Poteriocrinus, and eighteen other crinoids, are enumerated. Messrs. Wachsmuth and Harris describe *Heteroschisma gracile*, a new genus and species of Blastoidæ, and two other species of Blastoids. The Asteroidea are enriched by the addition of *Compsaster formosus* and *Cholaster peculiaris;* the Ophiuroidea by *Trematasterdifficilis*, and the Echinoidea by *Hybochinus spectabilis*, a new Peristodomus and three species of Archæocidaris. Only eleven molluscan species are given.

GEOLOGICAL NOTES.—*General.*—The age of the formations around Keff, in Tunis, has been determined by M. Maris by the aid of the fossils. There is a regular superposition of upper cretaceous, eocene and miocene. The middle eocene, or nummulitic beds, rest directly upon the Senonian or chalk, without the interposition of a lower eocene. The uppermost part of the cretaceous is very rich in fossils, especially in small echini related to Faujasia, and may belong to the Darian stage. The most interesting of the lower beds are those which enclose *Heterocerus polyplocum*, and correspond to the upper Senonian beds of Tercis, in Westphalia, and to the chalk of Meddon.

Tertiary.—M. Dieulafait's conclusions regarding the origin of the phosphorites and ferruginous clays of France are as follows:

(1) The quantity of phosphate of lime existing in the caverns of the south-west of France does not represent a tenth part of that which existed in the limestones, the removal of which produced the caverns.

(2) The ferruginous clays, which accompany and often cover the phosphates, have the same composition as those which are obtained by attacking with a feeble oxydating acid, the rocks constituting the walls of the phosphorite caverns.

(3) Rare substances, such as manganese, nickel, cobalt, zinc, copper, and iodine, which exist in the normal rocks of the phosphorite districts, are found in a relative state of concentration in the phosphorites and in their accompanying clays.

These results point to the possibility that the phosphorites of the calcareous plateaux of the south-west of France have, for the most part, if not entirely, been extracted from the encasing rocks solely by the influence of the chemical reactions of the humic method.

MINERALOGY.[1]

ALLANITE, APATITE AND TYSONITE CRYSTALS.—Professor E. S. Dana[2] has given careful crystallographic descriptions of allanite from Moriah, N. Y., apatite from Paris, Me., and tysonite from Colorado. The crystal of allanite was remarkable both for size and perfection, measuring 3¾ by 4½ inches, having smooth planes and being of a symmetrical shape.

The apatite crystal, of a deep blue color, was small (¼ inch in length), but beautifully modified. It was doubly terminated by pyramids of the third order, these hemihedral forms being unusually prominent. Two new planes for the species were ascertained.

The crystal of tysonite was the largest yet found, weighing fully two and a half pounds. Only a few planes were observed, but the

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Amer. Journ. Sc.*, 1884.

angle between O and 1, which was regarded as the fundamental angle, was determined to be O ∧ 1, 0001 ∧ 1011 = 38°25′ and 38°24½′. The length of the vertical axis is then $c = 0.68681$, and from this the other angles are calculated.

Curious Gold Crystals.—W. P. Blake[1] has described some curious forms of crystallized gold from Montana. There is a solid octahedral nucleus or head, with a long divergent brush-like appendage on one side, resembling the drawings made of certain comets. The appendages are many times longer than the octahedron, but the whole crystal is not over an eighth of an inch in length.

He also describes hexagonal prisms of gold terminated at one or both ends with pyramids. The planes are brilliant and the crystals show no signs of twinning. They are from Sonora, California.

Alkalies in Beryl—S. L. Penfield has shown that, so far as he has tested, all beryl contains more or less alkalies, sodium and lithium being always present, and sometimes cæsium. Water is also always present, and must be regarded in the formula. The alkalies, sometimes amounting to five per cent, are shown to replace the beryllium, and the formula $Al_4 Be_5 H_2 Si_{11} O_{34}$ is proposed as the one agreeing best with the analyses.

New Mineral Analyses.—F. W. Clark and T. M. Chatard, in the laboratory of the U. S. Geological Survey, have published[2] new analyses of the following minerals: (1) Jade and pectolite, from Point Barrow, Alaska, which are cut and polished by the Eskimo; (2) saussurite, from Shasta county, California; (3) allanite, from Topsham, Maine, where it occurs in slender black prisms, often rusty on the surface, and known by the quarrymen as "nails"; (4) damourite, from the topaz locality of Stoneham, Maine, both compact and micaceous; (5) margarite, from Gainesville, Ga., one specimen being of a bright pistachio green color, contrasting with the core of pink corundum, from which it radiates; (6) cimolite (?), a pink, earthy alteration product, encrusting albite and tourmaline, from Norway, Maine; (7) halloysite, in bluish white lumps, covered with a black coating of the oxides of copper and manganese, from near Mono Lake, California; (8) prochlorite, from Georgetown, D. C., of a dark green color; (9) halotrichite, occurring among a deposit of aluminous sulphates, which cover some two thousand acres at the headwaters of the Gila river, New Mexico; (10) alunogen, in variously colored crusts, from the same locality. New localities for several other minerals are also given.

Löllingite and other Minerals from Colorado.—At several mines in Gunnison county, Colorado, associated with barite, sid-

[1] *Amer. Journ. Sc.*, 1884.
[2] *Ibid.*

esite, galena, chalcopyrite, argentite, proustite, etc., there occur small, steel-like crystalline forms of radiated structure, often stellate, which have been shown by W. F. Hillebrand[1] to be a cobaltiferous variety of löllingite, an arsenide of iron. The crystals are often interpenetrated, and form twins and trillings, which again interpenetrate to form complex radiating masses, often several inches in diameter. The specific gravity is 7.4, and analysis showed the presence of over four per cent of cobalt, with small percentages of nickel, copper, bismuth and sulphur.

A related mineral, which occurred in thin blades with the löllingite, was shown to be an arsenite of cobalt, but not enough was obtained for analysis.

Cosalite was found in La Plata county in irregular masses of small size, having irregular fracture, a grayish-white color, and hardness of 3.5.

A sulpho-bismuthite of copper and silver, probably a new mineral, was found in a quartz vein in Park county. It was a bluish-gray substance, sometimes occurring in minute, slender, striated crystals. It will receive further investigation.

Hübnerite occurs in Ouray county in large flattened crystals, vertically striated and imbedded in quartz. It has a brownish-black color, pale yellow in very thin crystals. The composition agrees with the formula, $MnWO_4$.

Evansite.—The rare mineral *evansite*, a hydrous phosphate of alumina, heretofore found only in Hungary, whence it was brought in 1856 by Brooke Evans, after whom D. Forbes named the species, has recently been found by A. S. Woodward[2] in East Cheshire, England. It occurs in fissures in a fossiliferous shale and it is probable that like the vivianite of the New Jersey greensand beds, it is in part derived from organic matter. In physical characters the mineral agrees with the original evansite.

Tin from North Carolina.—In a recent number of the Naturalist reference was made to the discovery of tin at King's mountain, N. C. Dr. C. W. Dabney, Jr., has sent us further particulars concerning its occurrence at that place.

The cassiterite is mostly massive or crypto-crystalline; specific gravity 6.6–6.9; color generally dark brown, but varying from black to almost colorless.

The partial composition was ascertained to be as follows:

	(1)	(2)
Silica	1.76	2.36
Arsenic	....	trace
Sulphur	trace	0.46
Tungstic acid	0.92	1.14
Tin	74.41 (by wet method)	65.21 (by fusion)
Iron and manganese	undetermined	undetermined

[1] *Amer. Journ. Sc.*, 1884.

[2] *Mineralogical Magazine*, Vol. v, p. 333.

Specimen (1) was of a light grayish color, specimen (2) was dark brown.

Associated with the cassiterite is tourmaline, menaccanite, mica, zircon and rutile, the two latter scarce. Much of the cassiterite is in small grains with tourmaline.

NICKEL FROM NEVADA.—Important deposits of nickel ore have been discovered in Churchill county, Nevada. Some thirteen veins, varying in width from ten to thirty-five inches, traverse a ledge of rock, the gangue separating the veins consisting of silica, iron, lime and magnesia. As recently determined by S. B. Newberry[1], the ore at the greatest depth (eighty feet) consists of nearly pure niccolite. Nearer the surface oxidation products appear. At the ten feet level the ore is mainly the hydrated arseniate, or annabergite. There is every prospect that the nickel mines of Nevada will eventually become a prominent source of supply of this valuable metal.

VANADINITE.—Vanadinite in brilliant red and yellow hexagonal crystals is reported by F. H. Blake[2] as occurring in Pinal county, Arizona. Wulfenite occurs at the same locality. The vanadinite occurs in the seams of a partly decomposed rock resembling trap, covering sometimes five square inches of surface. The crystals are small and are generally simple hexagonal prisms whose prismatic planes are striated vertically, the opposite of what occurs in pyromorphite. Some few modifications also occur.

BOTANY.[3]

STRUCTURE, DEVELOPMENT AND DISTRIBUTION OF STOMATA IN EQUISETUM ARVENSE.[4]—The stomata develop less rapidly on the stem than on the leaves, and hence in order to study them in their earlier stages, it is best to cut a section of epidermis from a very young stem.

In the earliest stages I could find, the mother-cell of the stoma occurred as a cell of equal rank with the others, but was divided into four guard cells lying side by side, their longitudinal axes being parallel to that of the stem (Fig. 1 *a*). As the ordinary epidermal cells develop they grow more in length than in breadth, while the stomata grow equally in both directions, and crowd upon the surrounding cells (Figs. 1 and 3). In the meantime the outer pair of guard cells arch over the inner pair (Fig. 1 *b*) and finally completely cover them (Fig. 3). When mature, the guard cells are loaded with silica arranged in radiating bars (Fig. 3), and usually the inner pair is entirely hidden; but if a thin cross-

[1] *Amer. Journ. Sc.*, 1884.
[2] *Ibid.*
[3] Edited by PROF. C. E. BESSEY, Ames, Iowa.
[4] Selected for publication from original work of students in the botanical laboratory of the University of Michigan, 1883-'84.

section of a mature leaf be obtained, the two pairs of cells can be seen, one above the other (Fig. 2, *a a*, upper pair of guard cells; *b b*, lower pair).

With reference to the distribution of the stomata, Sachs makes the general statement that in the genus Equisetum they are always found in the furrows and never on the ridges; but *E. arvense* seems to be a partial exception to this rule, as upon the leaves the stomata are invariably on the ridges.

Taking the fertile plant, we find the leaves arranged in sheaths at the nodes of the stem; these sheaths are entire at the base but broken at the top into numerous teeth, which begin to diverge in the deeper furrows (Fig. 4 *e e*). Fig. 4 shows an outline section of a leaf taken about half way up; the upper surface is the outer one, on which the stomata are always located. It will be seen that between the furrows, *e e*, there is a smaller furrow, *m*, along the central line of the leaf. On the ridges, *b b*, the stomata occur, disappearing about two-thirds of the way from the base of the leaf where they are most abundant. Where the leaves join the stem the furrows, *e e*, are continued (Fig. 5 *e e*), the furrow *m* disappears, becoming continuous with the highest part of the ridge of the stem (Fig. 5 *m*). Fig. 5 is a section of one of the ridges of a stem; *a a* are the cells containing chlorophyll; where these touch the epidermis there is a slight elevation above the general slope, and on these places the stomata occur.

The distribution of stomata on the stem and stem leaves is alike on the fertile and sterile plants, but the branches have another method of arrangement. On the leaf of the branch (Fig. 6) there is no central furrow, but its place is taken by a sharp ridge (Fig. 6 *m*), and the ridges and furrows of the leaf are all continued on the branch. On the leaves the stomata are borne on either side of the ridge (*b b*), but on the stem they pass down into the furrows and lie on either side of the lowest part.

This arrangement of stomata in *E. arvense* is peculiar to the species, for in *E. limosum* and *E. hyemale* they lie, on the stem, exclusively in the furrows.

EXPLANATION OF PLATE XXXII.

FIG. 1.—Epidermis of stem (preserved in alcohol).

FIG. 2.—Cross-section of a stoma.

FIG. 3.—A mature stoma.

FIG. 4.—Cross-section of leaf of fertile plant.

FIG. 5.—Cross-section of ridge of stem.

FIG. 6.—Cross-section of leaf of branch.

—*Effie A. Southworth, Ann Arbor, Mich.*

THE DESMIDS OF THE UNITED STATES.—A new impetus will be given to the study of these beautiful plants by the publication of Rev. Francis Wolle's book, Desmids of the United States, lately received. Over four hundred and fifty species and va-

Fig. 1

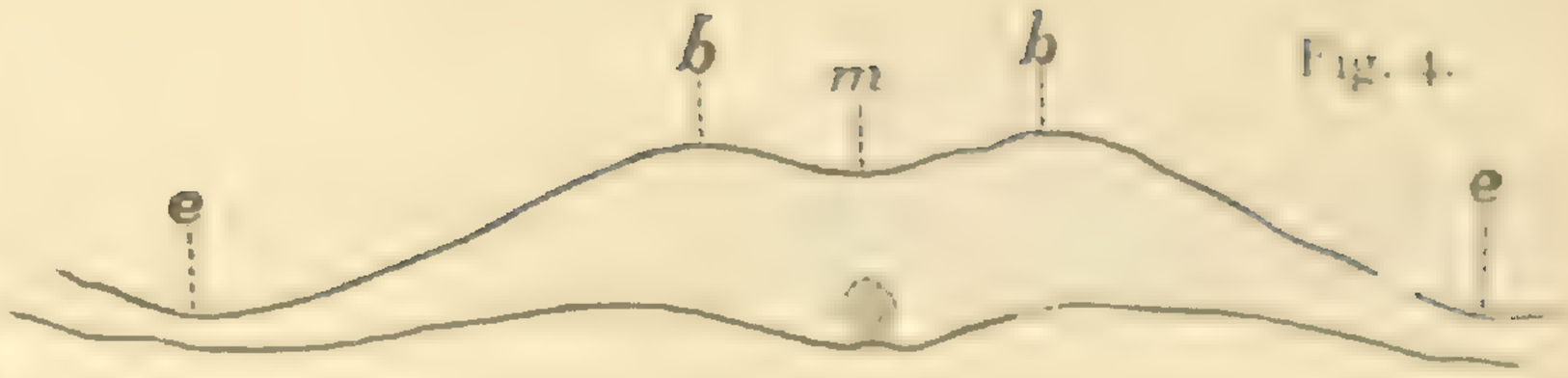
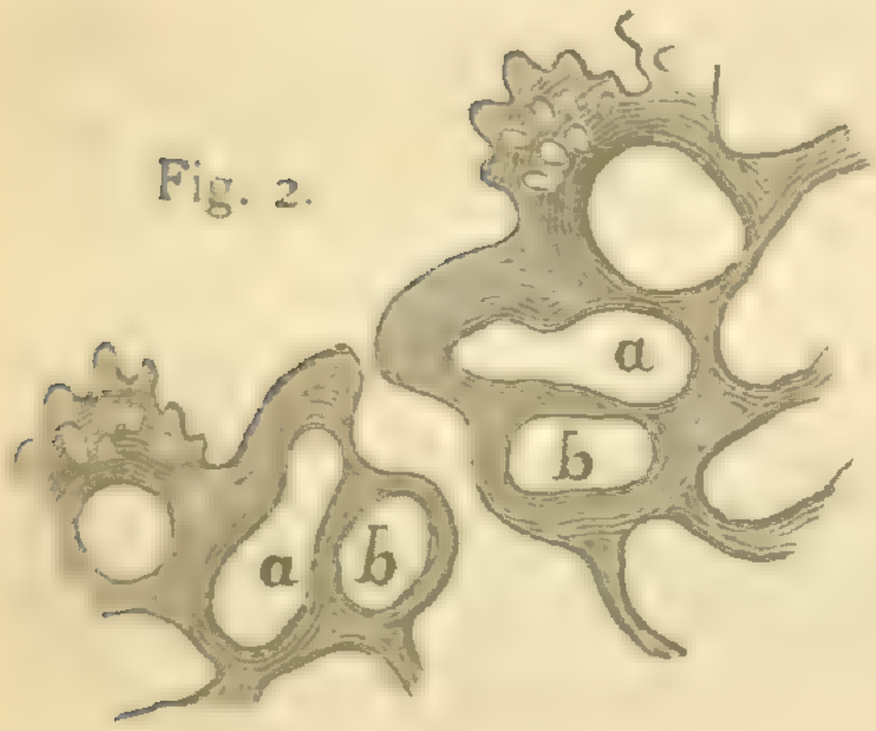


Fig. 4.

Fig. 2.



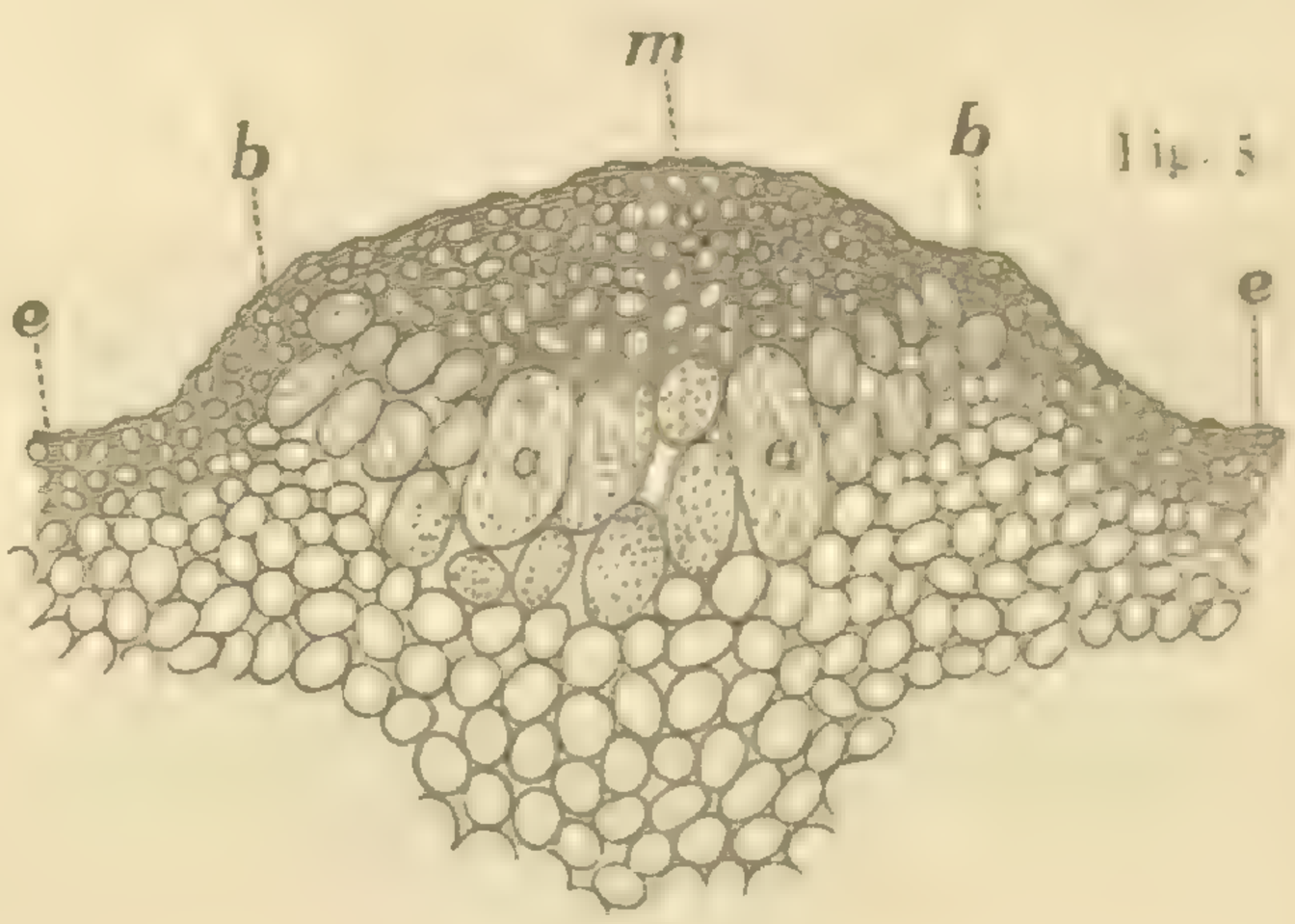
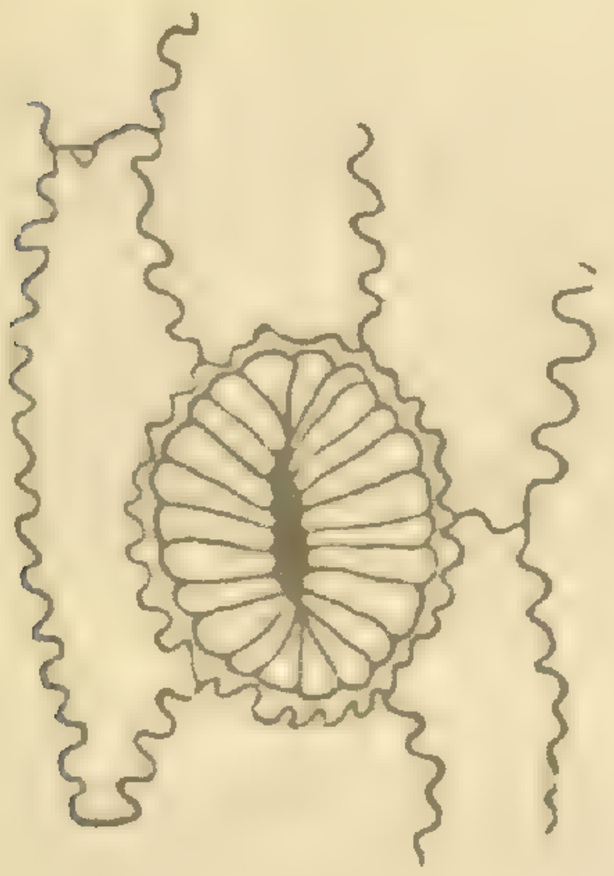


Fig. 5

Fig. 3.



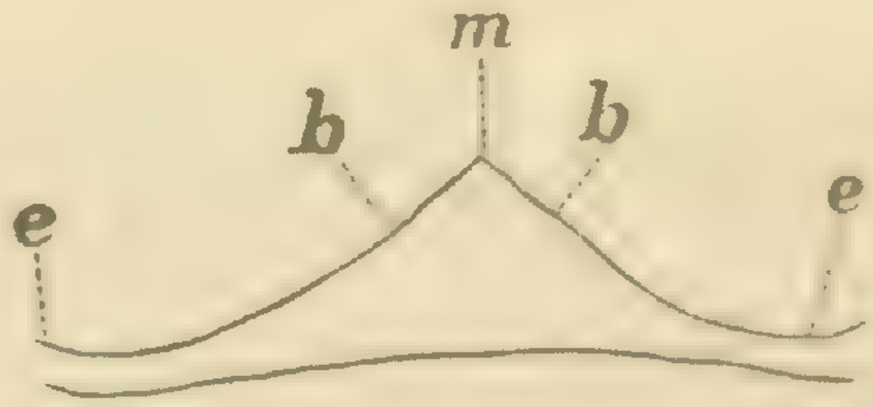


Fig. 6.

Stomata in *Equisetum arvense.*

marked varieties are described and figured with a fullness as to detail and coloring which leaves little to be desired. The fifty-three colored plates contain eleven hundred figures, most of which are magnified 500 times, relatively few being magnified 375 and 250 times. The making of these plates alone involved an amount of labor for which botanists will certainly be very grateful to the industrious author. That the work has been largely a labor of love is evident from the fact that it is sold for five dollars.

The following directions for collecting desmids (page XIII) will show the author's style, and may serve to incite some of the NATURALIST'S young collectors to search for these beautiful and interesting plants:

"The outfit need not consist of more than a nest of four or five tin cans (tomato or fruit), one within the other for convenience of carriage; ten or a dozen wide-mouthed vials, and a small ring-net made of fine muslin at the end of a rod about four feet in length. Should a boat be needed it can usually be hired on the spot. After selecting what seems to be a good locality, drag the net a few feet among the grasses and mosses, allow the bulk of the water to drain through the muslin, and then empty the residue into one of the cans; repeat this process as often as may be desirable. Ten or fifteen minutes after the cans have been filled, most of the surface water may be poured off and the remainder transferred to a glass vial, where the solid contents will gradually sink and the superfluous water can be again poured off and the vessel filled up with deposits from other vials. In shallow places what is known as swamp-moss (Sphagnum), bladderwort (Utricularia), water-milfoil (Myriophyllum) or other finely cut-leaf water plants are likely to abound; these should be lifted in the hand and the water drained or squeezed from them into a tin can to be subsequently treated as already stated. A few drops of carbolic acid in each vial, just enough to make its presence perceptible, will preserve the contents for months, and even years from deterioration; the green coloring matter (*chlorophyll*) may fade, but this, in the case of desmids, is of little importance; nevertheless, when practicable, always examine the materials when fresh. When dried on paper for the herbarium the specimens can still, after being moistened with water, be microscopically examined, but not with the best results, since the drying up is apt to collapse or otherwise distort the cells.

"The collector will not know the value of his find until it has been brought drop by drop under the lens of his microscope, and out of the entire mass he may discover nothing to reward his labors; this, however, should not discourage him, as one or two failures are to be expected prior to meeting with an adequate reward. His interest in the study will be greatly enhanced if he keeps a record of it in sketches of what the microscope reveals

to him. These sketches should, of course, be very exact, and in order that they may be so, it is necessary that the microscope should be provided with an eye-piece micrometer with which to measure the length and breadth of the figure to be sketched. * * It is so difficult to separate specimens from their accompanying foreign matter that it is seldom amateurs can mount them satisfactorily on slides, and therefore this method of preserving specimens is not open to recommendation."

Botanical Notes.—Dr. Gray's Revision of the North American species of the genus Oxytropis, communicated to the American Academy of Arts and Sciences, May 14, 1884, and but lately received, is an attempt to clear up some of the obscurities of the subject. Sixteen species are recognized as occurring in North America, but one of which occurs on the Atlantic coast, viz., *O. campestris* L., in Northern Maine, Lower Canada and Labrador. A second species, *O. lamberti* Pursh, occurs from the Saskatchewan river, Minnesota, and Western Texas, westward to New Mexico and Montana. Two varieties of this species are noted, viz., var. *sericea* (*O. sericea* Nutt.) from Wyoming to Texas and Arizona, and var. *bigelovii* (*O. lamberti* Torr., in Pacific R. R. Rept., IV, 80) on the Upper Canadian river. All the other species are from the Rocky Mountain region and Alaska.——With the foregoing we have also Notes on some American species of Saxifraga, by the same author.——Joseph F. James' Contributions to the Flora of Cincinnati, in the *Jour. Cin. Soc. Nat. Hist.*, contains many interesting notes on certain plants of the Cincinnati flora.——In an interesting paper, "Untersuchungen über die Bildung von centrifugalen Wandverdickungen an Pflanzenhaaren und Epidermen," just received, the author, Heinrich Schenck, discusses the thickening of the cell-walls of hairs and epidermal cells. A large plate with numerous figures illustrates the paper. —— *Drugs and Medicines of North America* is the name of a promising new quarterly illustrated journal devoted to the discussion of the botany, pharmacy, chemistry and therapeutics of the medicinal plants of North America. It appears to be worthy of support. It is published by Lloyd Bros., 180 Elm street, Cincinnati, Ohio, for $1 per year.

ENTOMOLOGY.

Life History of Lochmæus tessella.—The caterpillar of this moth is one of the most interesting among the Notodontians since it connects Cerura with the other genera, by reason of its two long caudal filaments, so much like those of Cerura. These appendages are simply modified anal legs, and seem to be tactile organs. This caterpillar is also interesting from its power when touched of forcing out a dense cloud of fine spray from a point near the head; exactly where this repugnatorial apparatus is sit-

uated is difficult to say; as yet I have been unable to find it with a hand-lens. It is very common on the oak, from Maine southward, in August and through September.

It is a large-bodied, pale green caterpillar, thickest in the middle, being somewhat spindle-shaped. The head is moderately large, flat in front, subconical, with the vertex high and conical, pale green, edged very irregularly with roseate on the sides. A small double reddish tubercle on the top of the prothoracic segment, from which a median white or yellow dorsal stripe, here and there marked with roseate spots, runs to the supra-anal plate. The anal legs are represented by two slender filaments held outstretched, which are nearly as long as the body is thick. There are seven pairs of oblique lateral faint yellowish slender stripes, the last pair extending to the sides of the anal filaments. All the legs are pale green and concolorous with the body. Length 40$^{mm.}$ including the filaments.

The young before the last moult have much higher prothoracic dorsal tubercles and much larger anal filaments than in the adult, and they are tinged with reddish. The cocoon is of silk, not very thick, spun between the leaves, and in confinement the moths issued in November, though ordinarily not due until June. —*A. S. Packard.*

Transformations of Caripeta angustiorata.—The caterpillar of this geometrid moth is common on the white pine in August and September in Maine and Rhode Island, where I have observed it, and is protected from observation by its resemblance to the smaller twigs of the pine. It is quite variable in its coloration. It is rather large and thick-bodied, the body being somewhat thickened at the first pair of abdominal legs. The head is slightly angular above, as wide as the segment next to it, the latter being rather small and not angular in front, but provided with small warts. On the metathoracic and abdominal (except second and third from the end) segments is a prominent transverse saddle-shaped ridge, ending on each side in a dark warty tubercle. On the penultimate segment are two dark, rather high dorsal tubercles, situated near together. Behind these two tubercles, and situated on a transverse wrinkle, are two small dark warts, and on a succeeding wrinkle are six warts; on the supra-anal plate are four warts, while on the edge, which is obtuse, are four small warts from which project four hairs. There are similar hairs on the edge of the anal legs, which have a deep crease parallel to the front edge, and two large spines. Lateral ridge rather prominent, interrupted at the sutures between the segments.

In color this larva is pale lilac, with whitish gray specks, being of a slate color or decidedly reddish, like a twig of the trees, and variously marbled with dark brown, or sometimes with greenish livid white. The head is marbled with transverse parallel waved lines. Length 30–32$^{mm.}$ August 8–9, at Brunswick, Me., it spun

a white web with minute meshes; the cocoon not being a loose one; and on the 9th it assumed the pupa state. The chrysalis is brown, sometimes green on the head and thorax, including the limbs and wings; with an obscure dorsal row of irregular spots, forming a nearly continuous line or band; and a lateral row of large obscure spots. On the second segment from the end of the legs are two warts. The spiracles are unusually distinct. Length $15^{mm.}$ The moths issued in May in the breeding boxes.—*A. S. Packard.*

The Limbs of Insects.—In his inaugural dissertation Dr. F. Dahl considers the structure and function of the limbs of insects. After the usual historical preface the author considers, without entering into anatomical details, the external structure of the leg, but devotes more space to the mechanism of the muscles. The insect limbs are then regarded from the point of view of their special functions, *i. e.* the limb as an organ of motion, whether on the ground, in water, or in the air. Under this head are given histological details, with figures filling three plates and showing the fine anatomy of the tarsal joints, claws and pulvilli as well as hairs, as well as the external appearance of the last tarsal joints of insects of different orders.

The limbs are then treated of as organs of prehension, including reproductive purposes as well as their uses in cleansing and combing the head, antennæ and mouth parts, with sketches of the different kinds of combs growing on the fore-legs of beetles, bees and wasps, etc.

Poison Glands in the Skin of the Cecropia Caterpillar.—Dr. Dimmock, in the course of a valuable article on "Some glands which open externally on insects," in *Psyche*, for September-October, 1882 (published in February, 1884), states that, if a Cecropia caterpillar "be examined carefully, the black spines upon its red, blue, and yellow knobs, or tubercles, will be seen to break easily from the tubercle, and a clear yellow fluid of disagreeable odor to ooze from each opening left by the injury. By crushing the tubercle with a pair of forceps, the same strong odor is very noticeable, and by this mode of treatment one has no difficulty in proving that each tubercle, small or large, blue, yellow, or red, contains the odorous fluid. The red tubercles are seen, in sections cut with the microtome, to be divided into compartments, the cavities of each spine opening into a compartment at its basal end. The spines themselves are quite rigid and very brittle, so that they break away at a slight touch, and leave a hole in the tubercle, out of which the odorous fluid pours, pushed by internal pressure. This fluid, which I have not examined carefully, but which I hope later to study chemically, is strongly acid to litmus paper, but causes a purple precipitate in carmine solutions." The odor given out by these glands suggests at

once their protective function. Similar glands, *i. e.*, with no outlet until one is produced by external agency, are not rare in bombycid larvæ. Karsten, in 1878, described the anatomy of the poison glands at the base of the hairs of an American Saturnia. The secretion is "perhaps formic acid or a formate in solution." The paper is crammed with interesting facts on this subject; among others it is stated that, according to Witlaczil, the "honey" secreted by the aphides issues from the anus, and not from the tubes on the sixth segment.

Malpighian Vessels of Lepidoptera.—M. Cholodkorsky has lately added *Lineola biselliella* to the list of the few insects that are known to have only two Malpighian vessels; these are of some size, and are folded along the course of the digestive canal, and end by a distinct enlargement. Luckow has described four Malpighian vessels in a species of Pterophorus and of Hyponomeuta, but later investigations show that they really agree with the great majority of the Lepidoptera in having six. As embryological research has shown that a small number of Malpighian tubules is a primitive character, and that with progressive development the number increases either by branching or by histolysis, succeeded by a fresh development of a larger number, it is clear that the Microlepidoptera in which there are but two, while their caterpillars have six, exhibit just the reverse to what we should expect, or in other words we have here a case of atavism, and one which as it obtains in the imaginal state only, is here a periodic rather than a constant atavism.—*Journal of the Royal Microscopical Society, June, 1884, p. 373.*

Transmission, Preservation and Mounting of Aphides.—G. B. Buckton gives the results of his experience as to the best mode of transmitting living Aphides, and also the best method for killing and preserving such like insects for future examination.

As to transmission, the chief thing to be guarded against is desiccation, and no plan seems to be so successful as their inclosure in ordinary quills stopped by plugs of cork and pellets of beeswax. The substance of the quill is sufficiently porous to prevent mildew on the one hand and a rapid evaporation on the other. In this way small insects may be sent through the post, and in a far better condition than can be secured in any tin boxes, even though they be filled with leaves. If a slip of somewhat succulent leaf be rolled round each quill, to retain moisture, a bundle will conveniently pass through the post.

For preservation (other than on a slide) the best plan is to drop the insects into small flattened glass tubes partially filled with a suitable liquid, then draw the tube to a fine point, break the end off, and warm the empty space (or, better, expel the air by a pump), and the tube can be entirely filled with liquid, and then sealed with the blow-pipe.

For mounting microscopically, five or a dozen spots of fluid Canada balsam should be dotted on a slide from the head of a pin, and by means of a hair pencil as many living insects transferred to them. The specimens at once adhere, and if the spots are small the insects spread out their limbs naturally, with a view to escape. They may be fixed on their backs or otherwise, according to the views desired.

A very thin glass cover, or, if very high magnifying powers are wanted, a small disk of clear mica, is laid over the insects, and then one or more drops of the fluid balsam are delivered from a glass rod at one of the sides of these covers. The balsam runs slowly under by capillarity, and it drives all the air before it, the small weight of the cover assisting it to spread, until the whole area is filled. No pressure is to be used, or the elastic bodies of the Aphides will change shape; and besides this, the juices will be forced through the cornicles and pores. If the balsam is thick, a very gentle heat, hardly exceeding that of the cheek, may be applied, but as a rule, the temperature of a room is better than that which exceeds it. The insects die immediately they are cut off from air, and in almost every case their position will be good for examination. To spread the wings of a small insect, the above-mentioned small dots may be made in a row. The belly of the specimen is applied to the middle spot, and by a bristle one wing may be applied to a dot on the one side, and the other wing to the third dot. The cover is then placed as before, and when the balsam runs in it will not disturb the position of the spread wings.

It will be noticed that very soon after live insects have been mounted in a resinous substance that will not mix with water, a white cloudiness forms around each specimen. This is caused by the watery juices of the insect, which chill the medium and make it opaque.

This cloudiness, however, entirely disappears after perhaps a month, the moisture being slowly carried outwards. The same is to be said of stray air-bubbles. The oxygen of the air unites with the balsam, and thus hardens it; but what combination is effected with the nitrogen is not so clear. However, air-bubbles in balsam disappear in time, provided the former is not in too hard a condition.

In cases when the above small pressure is undesirable, small circles, cut by round punches of different sizes out of very thin sheet lead, will be found more convenient to insert between the glass slip and its cover than circles of card, which are sometimes recommended. The thin sheet lead from the Chinese tea-chests is very suitable for punching, and as it is not porous like card, it yields no air-bubbles by heat.

D. Von Schlechtendal has described a method by which it would appear that all the characters of form and colour (?) may be preserved in Aphides and other insects. The method consists

of a rapid death and drying of the insect by means of a current of heated air. The Aphis, previously attached to some suitable support, is suddenly and momentarily subjected to the heat of a spirit or other flame, by which it is immediately killed and caused to retain its natural position. Several examples are then carefully roasted in a current of hot air, such as that passing through an inclined glass tube duly made hot, or dried on a sheet of paper moved over a heated metal plate.

When dry, the specimens are mounted on card by attachment with gum tragacanth, or, as Mr. T. W. Douglas suggests, more conveniently on mica, called "talc," in the shops, which, as it is incombustible, is well suited for a support both before and after drying.

This method is vouched for as good by Drs. Giebel, Taschenburg, Mayr and Rudow. I have not tried this roasting process, but it must require some address to prevent the shriveling of wings in such delicately formed insects, and to provide against the bursting action of the boiling juices. A more complete history of the process than the foregoing was given by Mr. Douglas in 1878.

M. Lichtenstein has many times been good enough to forward in letters to me preparations of Aphides which have been secured between two films of mica. The insects, he explains, are immersed in a solution of resin in turpentine, "a natural amber," and, when all are in due position, the mica films are placed over apertures in card, and then gummed papers, similarly perforated, are pressed upon them. This arrangement secures all in their places.

Methods and operations in science, like events in history, repeat themselves. Fifty years ago films of mica were used to cover objects for the microscope, and before the manufacture of the thin glass now so commonly used, it admirably answered its purpose. Under deep magnifying powers, such as one-half inch, it will be found even now of great service. The mineral may be split by the lancet into films much thinner than glass can be blown in a flat state. Small unscratched pieces may be selected which are perfectly transparent, and their cost is quite trifling.

On account of the high refracting power of Canada balsam, the colors of recently immersed Aphides show themselves very brightly; and it sometimes happens that tints, quite lost through irradiation or glance on the surfaces, become distinct by treatment with this resin.

The bright colors and markings of some species are due to the hue of the internal juices of the insects. These cannot be preserved by balsam, but it is otherwise with the pigments which stain the somewhat horny coverings of the thorax and abdomen. These colors are persistent.—*Journal of the Royal Microscopical Society, June, 1884, p. 467.*

ZOÖLOGY.

THE ORIGIN OF FRESH-WATER FAUNAS, A STUDY OF EVOLUTION. —Under this title Professor W. J. Sollas read a paper at a late meeting of the Irish Royal Society, which is reported in *Nature* for June 12. As no reference has been made apparently to work done in this country, it will supplement Dr. C. A. White's essays on the same subject. The poverty of fresh-water faunas as compared with marine is commonly attributed to a supposed inadaptability on the part of marine organisms to existence in fresh-water. That this explanation is inadequate is shown by the existence of fresh-water jelly-fish, such as Limnocodium, and still more directly by the experiments of Beudant, who succeeded in accustoming several kinds of marine mollusca to a fresh-water habitat. The view of Von Martens that the severity of a fresh-water climate is prohibitive of the existence of most marine forms in rivers is insufficient, and a more thoroughgoing explanation is necessary. This is to be found in a study of the means by which the distribution of marine animals is secured. In the case of stationary forms free-swimming embryos are distributed over wide areas by currents, and they can never pass from the sea into rivers, in which the current is always directed seawards. Nor, probably could an attached form once introduced into a river permanently establish itself so long as its propagation took place exclusively through free-swimming larvæ, for these would gradually be borne out to sea. Hence, fresh-water animals should not, as a rule, pass through a free larval stage of existence, nor, as a matter of fact, do they. In Hydra, fresh-water sponges, and Polyzoa, the young usually emerge from a horny cyst in the complete state. In the Unionidæ, the glochidium stage provides for distribution without involving a seaward journey. The young of fresh-water mollusks do not enter upon a free existence until they are similar to their parents, and Paludina is viviparous. The suppression of a free-swimming larval stage not only occurs in fresh-water, but in many marine invertebrates. This is connected with the fact that the larval stage is in a position of disadvantage as compared with the adult. Hence there is an advantage to the organism if the larval stage can be passed over in a state of seclusion. From this various other modifications follow; development in seclusion involves a supply of accessible food, hence the appearance of yolk, and other kinds of nourishment furnished by the parent to the imprisoned embryo. Again, the secluded larva being spared the drudgery of working for its own existence, and supplied with nutriment in a form that puts the least tax on its digestive powers, a larger balance of energy remains available for metamorphic changes. Thus arise the phenomena of accelerated and abbreviated development. Further, the shortening of the larval life probably leads to the lengthening of the adult life, and shifts the

chances of variation and selection forward into the adult stage. Thus animals which hatch out in a complete state will most probably suffer modifications of that state, and not of previous ones, except very indirectly. Here we discover a direct tendency towards a mode of development which explains the "arborescent" character of our zoölogical classifications, *i. e.*, the tendency of the tree of life is now to produce leaves rather than new branches. In the case of fresh-water fauna very direct reasons have existed for the suppression of the free larval stage. In this connection may be noticed the richness in species and the poverty in genera of the fresh-water mollusca. In discussing the origin of fresh-water faunæ, there are three hypotheses from which we have to select: (1) That marine forms have immigrated into rivers; (2) that they have migrated into marshes and thence into rivers; and (3) that marine areas have been converted into fresh-water ones. The last course has been the most usual, especially in the case of non-locomotive forms. Hence the origin of fresh-water invertebrates is connected with the great movements which have affected the earth's crust. The earliest well known lacustrine areas are those of the old red sandstone, in one of which we meet with the earliest known fresh-water mollusk, *Anodonta jukesii* (Forbes). The lakes of the Permo-Triassic period contributed additions to the fresh water fauna of the globe. The Neritidæ and Melaniidæ are so closely connected with them they may be regarded as their collateral or direct descendants, and thus may have originated in Triassic lakes, but not earlier. Other genera probably arose at the same time; the occurrence in Cretaceous deposits of Unio, Physa, Valvata and Limnea in the Nearctic, Palæarctic, and Oriental regions, suggests a high antiquity for these genera; and they may have existed in Palæozoic times. The lakes of the Tertiary period furnished probably further contributions to our fresh-water fauna, such as Lithoglyphus and Dreissena. Thus, existing fresh-water genera are probably descended from marine forms which became metamorphosed in the waters of the Devonian, Triassic, and Tertiary lakes. In the lakes of Central Africa the Tertiary fresh-water fauna still survives, nearly all of the genera from Lake Tanganyika being referable to genera already in existence in Mesozoic and Tertiary times. The lakes of the northern hemisphere received on subsiding beneath the glacial sea such Arctic forms as *Mysis relicta* and *Pontoporeia affinis*, but most of their existing inhabitants have re-entered them since their emergence from the sea.

Shells of Anticosti.—When leaving Ottawa in the summer of 1883 to study the flora of Anticosti, Professor Macoun promised me that he would endeavor to make as complete a collection as possible of the land and fresh-water shells of that little known island. The result of his labors is most gratifying, and shows that they were energetically and intelligently directed. His col-

lection was some time since placed in my hands for determination, and I have now much pleasure in submitting a list of the shells to the many students of science who take an interest in the distribution of the Mollusca.

Land Shells: *Helix hortensis* Müll.; *Macrocyclis concava* Say; *Hyalina nitida* Müll.; *Patula striatella* Anthony; *Conulus fulvus* Drap.; *Vallonia pulchella* Müll.; *Helicodiscus lineatus* Say; *Vitrina limpida* Gould; *Cionella subcylindrica* L.; *Pupa muscorum* L.; *P. pentodon* Say; *P. hoppii* Möller; *Vertigo gouldii* Binney; *Succinea obliqua* Say; *S. ovalis* Gould; *S. avara* Say; *S. verrilli* Bland.

Fluviatile Shells: *Limnæa stagnalis* L.; *L. palustris* Müll.; *L. emarginata* Say; *Physa heterostropha* Say; *Bulinus hypnorum* L.; *Planorbis bicarinatus* Say; *P. campanulatus* Say; *P. deflectus* Say; *P. parvus* Say; *Valvata sincera* Say; *Pisidium abditum* Hald.; *Anodonta fragilis* Lamarck.

Professor Macoun was informed that a large kidney-shaped mussel occurred in Fox river—a locality which he was unable to visit. This shell no doubt is *Margaritana margaritifera*—already recorded from Anticosti by Professor Alpheus Hyatt. *Acanthinula harpa* Say, was not observed, although from being found on the mainland opposite, in Gaspé, and inward along the St. Lawrence to Montreal, its presence might be expected. Both the plain and banded forms of *H. hortensis* were collected, but none of var. *nemoralis*. *Vallonia pulchella* is the strongly ribbed variety (*costata* Müll.), which has not, I believe, been found elsewhere in Canada, where the typical form is very common, but which is known to occur at various points in the United States. *Succinea verrilli* does not seem distinguishable from *S. avara*, otherwise than by its want of the protective covering so characteristic of the latter shell. The Limnæa referred to *emarginata* is somewhat doubtful, but is probably that species. The Anodonta is quite distinct from the pale, thin forms of *fluviatilis* which it is the custom to call *fragilis*, and probably more nearly approaches Lamarck's species—originally described from Newfoundland—than any shell found in the interior region. It will be observed that the list includes nearly all the shells which are common to America and Europe. Of these *Conulus fulvus* has the most extended distribution north and south, while others of them—*Cionella subcylindrica*, *Patula striatella*, *Bulinus hypnorum*, *Limnæa stagnalis* and *L. palustris*—range with it across Canada to Vancouver island. —*Frank R. Latchford, Ottawa, Ont.*

Gill on the Habits of Fishes.—Professor Gill gives the following notes in a late number of *Forest and Stream*: "We have an interesting instance of the female of one type of catfish found in South America, the Aspredinidæ, in which there occur periodical swellings of the skin of the abdomen in which the eggs are received, and therein they are nourished for some time. Again

in the same group, or order of catfishes, but in another family, the Arii, the male parent takes care of the eggs by holding them in his mouth, and so preserving them from danger very skillfully. Care is taken of the young by other species of the family. It was with great interest that some months ago Mr. Ryder and myself observed the habits of our common catfish. The male hovered over the young, and when feeding, frequently took the young into his mouth, but always ejected them again, thus discriminating accurately between the objects taken as food, and the young fish accidentally transferred to his mouth. This same habit of taking care of the young in the mouth is exhibited by certain Cichlids, forms somewhat like, and perhaps akin to, our common sunfishes. One of these is a fish found in the Holy Land, a species of Chromis. And the same peculiar habit is likewise manifested by species of the same family living in South America, the Geophagi. The belief was also long current, and found expression in most of the old books, that fishes not only did not take care of their young, but were invariably oviparous. We all know now how false such a statement is. In one class, the Selachians, the larger proportion of forms are viviparous. For example, of the sharks proper, three-fourths or more are viviparous, and the same statement holds good with respect to the rays or skates. Thus, out of 150 species of rays, over 100 are viviparous, and another noteworthy fact is that the oviparous rays are nearly all included in one family—the common skates or rays brought to our markets. This feature of viviparity was known to the ancient naturalist, Aristotle, who went even so far as to say that the Selachians were viviparous, while all scaly fishes were oviparous. There, however, he erred, for there is no such limitation. Many of the Selachians are oviparous, and, on the other hand, many of the scaly fishes are viviparous. For instance, all the Embiotocoids are viviparous, and of these the common perch of the Pacific is an example; also viviparous are the eelpout of our markets, and species of the Cyprinodont family among others. Viviparity is, indeed, largely manifested among fishes. The only reason why reverse statements are found in the old books is that in Europe these cases were almost unknown. I agree with the statement of Mr. Ryder that confinement frequently affects the power of procreation, either directly or indirectly, and this does not apply to fishes alone, as is evident from the experience of those in charge of menageries and zoölogical gardens. It is known that many animals and birds which are confined seem to live with perfect freedom in zoölogical collections, but they do not bring forth young, or their eggs are sterile. There are many exceptions to this rule, but many cases of sterility for which we can assign no other cause. Somewhat analogous is the peculiar pathological condition of animals living in confinement, in which the bones become softened or rickety."

HIBERNATION OF THE GRAY GROUND SQUIRREL.—On January 18, last, I was fortunate enough to have brought to me, by a farmer residing near here, a gray ground squirrel, *Spermophilus franklini* in the hibernating state.

The squirrel, or gopher, was rolled up in a perfect ball, his head resting forward of the root of his tail, and the tail curled carefully up on the body of the ball. The gentleman also brought with him about one-half of the nest in which the gopher was found, the gopher still resting in it. The nest was made of common lowland grass (cured), and was merely a nicely collected ball of hay without any sign of a place of entrance, but had instead every appearance as though some brother gopher had built the nest around the body of the hibernator. This ball of hay or nest, was about twelve or fourteen inches in diameter, and was found by the farmer and some workmen in a hay stack on his farm. The nest was in the center of the stack, which was large, and had stood in the field two years. No other nest was found. When the workman who was pitching hay from the stack, came to this ball of hay, he kicked it to one side, but the farmer considering it a strange discovery to find frozen hay in the center of such a large stack, though water run down into it, carried it home for examination, and in turn was so well pleased with the discovery of the sleeping marmot, that in his enthusiasm he brought the animal to me the next day; forgetting, by the way, to consider that a change of temperature might kill it, as he kept the animal exposed to the very cold freezing weather we had at that time, during the night and until noon the next day, the time of delivery to me. The animal when placed in my hands showed no signs of life, excepting in the healthy condition of the hair and soles of its feet; in this observation no one could deny that life existed, and that the animal was in perfect health. Anticipating that the sleeper would live, I prepared a cage, placed him in it, intending to test the various degrees of bodily heat-temperature as spring approached, and he was expected to awake from his winter's nap. His weight at this time was 15¾ ounces.

The weather increased in severity, and not having a place to keep him in, which I believed could be kept in as regular temperature as I supposed the haystack to have been, I placed it where I thought I could come the nearest to it; but in which I fear I must have failed, for upon examination after ten days in my possession I discovered that the gopher had withdrawn his nose from its pressure against his stomach, his tail did not hold the like position I had several times noticed during the ten days I had had it, his feet were withdrawn from their symmetrically laid position upon each side of the center of the junction of the neck and the hinder parts of the body, which the tail previously had so perfectly covered; the body was now limp, and there was evidence of a hemorrhage, having come through the mouth and

nostrils; but otherwise the appearance of the animal was as life-like as when I first saw it. At various times thereafter I examined it, but only to discover no change to prove that death had taken place, until about the 15th day of March, when I discovered that putrefaction had set in; the body was then disposed of.

The question with me now is, Did this gopher die upon his being changed from the temperature of the haystack to the excessive cold of the night and day following, or did he merely become affected sufficiently with the other changes that followed to produce hemorrhage, and in this reduced condition did he not then have vitality enough to carry him through the hibernating condition, and died because wanting this power?—*D. H. Talbot.*

The Varying Hare.—This species derives its name from the well-known circumstance that it changes color in spring and fall—being dark reddish-brown in summer and snowy white in winter. Concerning the method of the change much difference of opinion exists, and some of the ablest of recent writers pass the point in silence.

Pennant says: "These animals, at approach of winter, receive a new coat, which consists of a multitude of long white hairs, twice as long as the summer fur, which still remains beneath."[1] Dr. Richardson stated that, in his opinion, "the change to the winter dress takes place by a lengthening and blanching of the summer fur; whilst the change in the beginning of summer consists in the winter coat falling off during the growth of the new and colored fur." This opinion comes very near the truth, but does not express the whole truth. The first clause is absolutely correct; for in the fall the change certainly does occur "by a lengthening and blanching of the summer fur," the individual hairs changing color after the first fall of snow. This species, like the great majority of mammals, is clothed with two kinds of hair—a fine soft fur which densely covers all parts of the body, and longer, stiffer hairs, scatteed through, and projecting beyond the former. These long hairs are black in summer and white in winter. In the fall of the year, when the change begins, they become white at the tips first, the black gradually fading from above downwards, until the entire hair is white. In spring the process is reversed, the exposed portion of the long hairs becoming black (though the extreme tip sometimes remains white until the change is far advanced), which color gradually extends downward, at the expense of the white, until the entire hair is black. Sometimes the displacement of the white is temporarily interrupted, the two colors appearing in alternate zones. And during the latter part of March, when the body of the animal is still white, it is not uncommon to find hundreds of black hairs scattered over the back, many of them with the extreme apices, and a narrow zone between the middle and base,

[1] Arctic Zoology, Vol. I, 1792, p. 110. *Lepus americanus.*

white. In fall or early winter the soft fur becomes tipped with white, the white portion increasing somewhat in length and diameter. In spring a curious phenomenon takes place. The white portion of the fur loses its vitality, becomes brittle, and breaks off on slight friction, so that the animal, in brushing through the undergrowth, soon rids himself of it. As a rule the long hairs change first.[1] Both in spring and fall the time of the change seems to be governed by the presence or absence of snow, and is not affected by the temperature. It occurs independently of the moult, and the new hairs assume the prevailing color of the animal, or the color toward which it is tending at the time of their appearance.—*C. Hartt Merriam, from advance sheets of the Transactions of the New York Linnæan Society, Part ii.*

Food of Cats.—The note by Mr. Dimmock, of Cambridge, in the September number of the Naturalist, upon the food of cats impels me to speak of my pet kitten. She refuses milk utterly if she can be supplied with anything else. She eats cooked green-corn with a relish. In this connection a friend informs me that he has frequently fattened cats this way. Indeed, they will steal the cobs out of swill pails. My kitten will catch and eat moths and the water bugs of the kitchen. Her patience in watching a moth outside the window-screen, the other night, gave me much amusement; she followed its every motion, and finally mounted to the top of a step-ladder and from thence made springs at the window. The moth was all unconscious of the very slight yet effective interposition of the screen.

I have known cats to eat clams to such repletion that they died. Fishing cats are by no means uncommon.—*W. W. Bailey. Providence, Aug. 25, 1884.*

On the remarkable Skull of an Idiot twenty-one years old.—In a communication to the Anthropological Society of Brussels, M. P. Albrecht proceeds still further in his work of suggesting fresh relationships among the bones of the skull. The basioccipital is, according to our author, primarily formed of two bones, the true basioccipital, which is the centrum to which the exoccipitals are the neurapophyses, and the *basiotic*, which is the centrum to which the periotics or petrosals are the neurapophyses. This imports an additional vertebra into the cranium, and makes the periotics a primary part of it, instead of an adaptation for the organ of hearing. Every bone of this malformed skull is thoroughly described and lessons of homology derived from it. The sketches of the right temporal of this idiot and of a horse

[1] Specimens in my museum, killed in Lewis county, December 1st, March 21st, and April 3d, well illustrate the above described conditions of pelage. In spring, while the change is in progress, the attachment of the white tips is so feeble that hundreds may be blown off at a single puff. The change occurs more or less irregularly over the greater part of the body, but is usually symmetrical on the head, giving rise to a very pretty pattern.

just born show the temporal divided into squamosal, quadrate and mastoid, while the malar is, in the idiot skull, divided by a vertical suture into a premalar and postmalar (post frontals, anterior and posterior). The "Japanese bone," formed by a horizontal suture, cuts off a hypo-malar, which M. Albrecht identifies with the *quadrato-jugal.*

This treatise, like all others from this investigator, deserves careful attention. However he may appear to controvert current theories, it cannot be denied that he is pointing out homologies between the bones of the mammalian skull and those of lower vertebrates, some of which have hitherto baffled morphologists.

ZOOLOGICAL NEWS.—*General.*—In the fifth part of Archiv für Naturgeschichte, 1883, the work of the year 1882 in various departments of zoölogy is reviewed. The articles upon the mollusks and fishes are by Professor E. Von Martens. American work occupies a prominent position, especially in Ichthyology. The reviews of the progress in ornithology and mammalogy, are by Herr V. Ant. Reichenow, and here again American work is conspicuous. Dr. Oskar Bœttger reviews the herpetology. As not only separate works, but all articles upon the various branches of zoölogy are mentioned, and as geographical distribution, palæontology, etc., are kept apart, these reviews will repay examination. The whole of the fourth part of the Archiv für Naturgeschichte for 1883 is occupied with a review of the progress made in entomology, carcinology, and in the knowledge of the Arthropoda generally during 1882. The reviewer is Dr. Ph. Bertkau, of Bonn.——Dr. El. Metschnikoff (Arb. aus dem Zoöl. Inst. der Univ. Wien., 1883) gives particulars of the intercellular digestion of invertebrates. The ectodermal digestion of sponges and polyps, and digestion through wandering mesodermal elements are shown to be an evidence of the descent of the Metazoa from colonies of Protozoa.

Cœlenterates.—Dr. Claus (Arb. aus dem Zoöl. Inst. Wien., 1883) describes the ephyra-stage of Cotylorhiza and Rhizostoma.

Worms.—M. G. Pruvot has, at Banyuls-sur-Mer, investigated the nervous system of the Eunicidæ, and finds: (1) That the cerebral mass is composed of two distinct parts; a cerebral and a stomato-gastric; (2) That the antennæ and sense-organs are supplied with nerves entirely from the cerebral center, and that the odd posterior antenna represents a pair of appendages that have united on the median line; (3) that the stomato-ga-tric center furnishes all the nerves of the palpi and the stomato-gastric connections; (4) That the stomato-gastric system has essentially the same disposition as the general nervous system; consisting of a sub-œsophageal center, an œsophageal ring, and a ventral chain, the latter consisting of at least two ganglia, the lowest of

which appears to be formed by the union of two.——M. Poirier and Rochebrune have carefully described *Lophobdella quatrefagesi*, a hirudinean which resides in the mouth of *Crocodilus vulgaris*, *cataphractus* and *leptorhynchus*, and also upon the lingual papillæ of *Gymnoplax ægyptiacus* and in the pouch of *Pelecanus crispus* and *onocrotalus*.

Mollusks.—Dr. Carl Grobben contributes to the Arbeiten aus dem Zoöl. hist. Univ. Wien, 1883, the results of his studies of the urinary and generative organs as well as of the body-cavity of the Cephalopoda.——Herr Von Vincenz Hilber (Sitz. der Kais. Akad. der Wiss. Wien, 1883) describes the land-snails of China, gathered by Ludwig V. Loezy, geologist of Count Szechenyi's expedition. Twenty species are detailed, of which eleven are given as new. The memoir is accompanied by a complete bibliography.

Crustaceans.—Dr. Wilh. Müller (Archiv. für Naturgeschichte 1884), contributes a memoir upon the Cytheridæ. He describes fully the male and female sexual organs, also the pair of appendages situated between the first locomotive limbs, and then catalogues the species found in the Baltic and North seas. Thirteen species, in eight genera, are enumerated, including *Cytherois virens*, nov. gen. and sp. In another article in the same issue Dr. Müller describes *Longipedina paguri*, a copepod which resides in the shell-habitation of *Pagurus bernhardus*.

Reptiles.—In the first part of the Archiv. für Naturgeschichte, 1884, Dr. J. V. Bedriaga gives a thorough description of two species of Amphisbæna, *cinerea* and *strauchi*, with enlarged figures of the heads of both, from above, below, and laterally. Numerous examples of *A. cinerea*, from various parts of Spain and Portugal, as well as from Morocco, were examined, and the species is said to occur at Constantinople, and also *A. strauchi*, the distinctness of which is evident, is common at Smyrna, when the specimens examined were collected, and Dr. Bedriaga believes that the *A. cinerea* that has been said by authors to occur in Rhodes, Cyprus, Magnesia, etc., and perhaps even that of Turkey and Greece may prove to be really *A. strauchi*. The skull and soft parts of Amphisbæna are fully described in the memoir.——The Egyptian Naja has been found in Tunis. A fine example 1.55^{m} long was taken by M. Valery-Mayet at the well of El-Aia.

Mammals.—M. Paul Albrecht, in a communication to the Anthropological Society of Brussels, describes the "vermian fossette" of the skull of mammals. He finds that this fossette, situated between the right and left cerebellar fossettes, and marked externally by a protuberance, is common to mammals in general. M. Albrecht has found it in the monotremes, marsupials, edentates, ungulates, Cetacea, Sirenia, Carnivora, Rodentia, Insectivora, bats, and most monkeys. The thickness of the skull

in ungulates prevents this central fossette from appearing as an eminence on the outside of the skull, and in the dolphins the crest between it and the cerebellar fossettes is not prominent, but the vermian fossette is absent only in the orang, chimpanzee, gorilla, and man. In all these it appears occasionally. It was first found in man by Cesare Lanbroso (1871), in the skull of a criminal, and has since been frequently noted in criminals, madmen, and inferior races, especially among the Aymara, whence it has been called the "aymarian fossette." Its occurrence in the higher apes and man must therefore be considered as a mark of atavism. ——Paul Reichart, writing from Mpala, on the west coast of Tanganyika, states that the Sako (Soko) is very common in that locality. A nest was found some five hundred meters from a village. It was about ten feet above the ground, resembled the nest of a large bird of prey, and was unprotected above. The Sako sets within the nest, not under it. A band of Sakos, from six to twenty strong, frequents the neighborhood of a village. Herr Reichart compares the cry of the Sako to that of man and wife when quarreling, and characterizes it as diabolical. Mingled with this are deep bass tones and cries deceptively like those of a child. The animal is about 1.3 meters (about four feet three inches) high, very strongly built. The natives fear him more than they fear the lion, so much so that they abandon a road if a band of these apes take up their abode near it. An example of the *Balæna cisarctica* was cast ashore at Taranto, southern Italy, in 1877, and another was captured at Guetaria, not far from San Sebastian, Spain, on February 11, 1878.——At the meeting of the Royal Microscopical Society, June 11, Mr. Hazlewood called attention to human spermatozoa with two tails.——M. Testut read a paper July 7, before the French Academy on the results of his dissection of a Bosjesman from twelve to fourteen years old. The muscular system was in a more or less rudimentary state, which exists in a normal condition in various anthropoid apes and monkeys, and in some instances even in mammals of other orders. M. de Quatrefages in his remarks attempted to point out that these facts supplied no fresh arguments in favor of man's descent from a Simian prototype.

PHYSIOLOGY.[1]

THE CHOLERA BACILLUS.—The reports of the commissions under the direction of Dr. Koch, sent by the German government to Egypt and India to investigate the cause of the cholera epidemic, are of great scientific and practical interest. It was attempted early in the research to find some bacterial organism whose presence was peculiar to the disease. This was long-tried in vain, chiefly on account of the large number of diverse forms of bacteria found in the intestines of cholera patients. But finally

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

a peculiar comma-shaped bacillus was settled upon, and found thereafter uniformly present in the intestines of subjects dead from cholera or in the evacuations from cholera patients. This "cholera bacillus" cannot be obtained from healthy people, though other bacteria occur in their evacuations, and it is absent from patients suffering from other diseases, such as dysentery, which resemble and often precede cholera. Says Dr. Koch, "In the last report I could already state that the peculiarities of the cholera bacteria were so well determined that they could safely be distinguished from others. Of these characteristics the following are the most striking: The bacilli are not perfectly straight, like other bacilli, but slightly curved, like a comma. The bending may go so far that they take the form of a half-circle. In the pure cultivation from these bent rods often arise S-formed figures, and more or less long, slightly wavy lines, of which the first are made up of two, and the last of a large number, of the cholera bacilli, which, by continued increase, have remained connected. They possess powers of locomotion, which can best be seen, and in most marked degree, in a drop of cultivation-liquid suspended on a cover-glass; in such a preparation, one sees the bacilli moving with the greatest velocity in all directions through the field. * * * Its presence is restricted to the organ in which the disease is—the bowels. In vomit, they have, as yet, only been noticed in two cases; and in both the appearance and alkaline reaction of the vomited fluids showed that the contents of the bowels, and with these the bacteria, had got into the stomach. In the bowels their history is as follows: In the first evacuations of the patient after the attack, as long as they have any form, very few cholera bacilli are present; the watery, odorless evacuations which follow, on the contrary, contain the bacilli in great numbers; while, at the same time, all other forms disappear almost entirely, so that, at this stage, the cholera bacilli are cultivated practically alone in the bowels. So soon as the cholera attack lessens, and the evacuations are again fœcal, the comma bacteria disappear gradually, and are, after convalescence, no longer to be found. The same is found to hold in cholera subjects. In the stomach no cholera bacilli were found. The bowels varied, according as death had occurred during the cholera attack or after it. In the freshest cases, the bowels showed a clear, red color; the inner lining of the intestines was still free from submucous extravasation; and the contents consisted of a colorless, odorless liquid; the cholera bacilli were present in enormous masses, and nearly pure. Their distribution corresponded exactly with the degree and spread of the inflammation of the lining membrane, the bacilli being generally not so thick in the upper intestine, but increasing toward the lower end of the smaller intestine. When, however, death has taken place later, the intestines show signs of an important reaction. The lining is dark red in the lower part of the small intes-

tine, impregnated with extravasation of blood, and often dead on the outermost layers. The contents of the bowels are, in such cases, more or less blood-colored, and, in consequence of the reappearance of the bacteria of putrefaction, putrid and fetid. The cholera bacteria at this stage begin to disappear, but continue still to be present for some time in the solitary glands, and in their vicinity—a circumstance which first called attention to the presence of this peculiar bacterium in the bowels of the Egyptian cholera subjects. They entirely fail in such cases, only when the patient has lived through the cholera, and dies from the after-weakness. The cholera bacteria act exactly as other pathological bacteria. They occur only in their peculiar disease; their first appearance is when the illness begins; they increase in number with the severity of the attack, and gradually disappear as the illness wanes. They are found where the trouble exists; and their number at the height of the disease is so great, that their injurious effect on the lining of the intestines is explained. * * * In the linen of cholera patients the bacteria increase in the most remarkable manner, when the clothes have been soiled with the evacuations, and then, for twenty-four hours, have been kept in a moist condition. This explains the known fact that the people having to do with such affected linen are often attacked. * * * Another peculiarity of the cholera bacteria is, that they die, upon drying, much more quickly than most others. Commonly all life is extinct after three hours' drying. It has been noticed that their development only takes place well in substances having an alkaline reaction. A very small amount of free acid, which would have little or no effect on other bacteria, puts a marked check on their growth. In a healthy stomach they are destroyed, which is shown by the fact that neither in the stomach nor intestines of animals which have been constantly fed on cholera bacilli, and then killed, were any found. * * * Perhaps, when the digestion is imperfect, the bacilli may be able to pass the stomach; and the fact observed in all cholera epidemics and in India, that those suffering from indigestion are especially subject to cholera, may bear out this view."—*From the translation of Koch's Report in Science.*

PSYCHOLOGY.

ROMANES' MENTAL EVOLUTION IN ANIMALS.[1]—This volume is in continuation of the author's Animal Intelligence, and as the title indicates, it is largely speculative. The argument assumes the truth of the theory of evolution, and that phase of it known as Natural Selection; indeed, the author seems thoroughly committed to the latter theory, since, on p. 62, he insists that "the method of nervous evolution has everywhere been uniform," a

[1] *Mental Evolution in Animals.* By GEORGE JOHN ROMANES, with a posthumous *Essay on Instinct.* By CHARLES DARWIN. New York, D. Appleton & Co., 1884. 12mo, pp. 411. $2.

statement which is not only too dogmatic, but, if we understand the author's meaning, is opposed to many facts; as we find remarkable cases of reasoning power in orders and classes, which are generally considered structurally low; for example, the wood ants among Pseudoneuroptera, and the beaver among rodents. One chief objection to the author's theory of uniform nervous evolution, is the occurrence of what are usually regarded as unexpected, unlooked-for evidences of comparatively high intelligence in groups where they are, so to speak, normally absent. And it is these sudden or, so to speak, capricious instances, the occurrence of sports or new varieties of plants and animals which may or may not be perfected and transmitted, and which the convenient expression "saltatory evolution" covers, which suggest the occasional sudden origin of mental traits. If the principle of sudden, saltatory evolution be granted, the task of accounting for the rise and transmission of mental traits will be if not much more simplified, at least more readily appreciated and accepted. It will be more in accordance with nature, for uniformitarianism in geology has its catastrophic crises; the vegetable and animal series have their broken branches, sudden degradations and lapses, and why should nervous evolution alone be "uniform in its upward development?" Mr. Romanes, like most of his countrymen, is a devout and blind follower of the late Mr. Darwin, and, like most disciples, carries out his special theory of natural selection with more of dogmatism and unwavering trust than his master.

Barring then the particular working theory upon which the essay is grounded, we find little to criticise and much to endorse in the work before us. Mr. Romanes has been careful in his selection, and, where possible, verification of his facts, and in most cases his inferences command our assent. It was not his intention evidently to treat the matter historically, for the literature of the subject of animal intelligence is voluminous; but the method of handling the particular theory upon which the work is based is, next to Darwin, original with our author, and the book will doubtless remain a classical contribution to speculative biology. As others before him, Mr. Romanes decides that an organism has a mind when it makes an intentional choice, and that such a choice is a conscious one, as opposed to reflex actions. After devoting a chapter to the structure and functions of nerve-tissue the author next turns to the physical basis of mind, and considers in a necessarily inconclusive way, from the standpoint of natural selection, *i. e.*, uniformitarianism exclusively, the relation between the mass of the brain and degree of intelligence.

The root principles of mind are seen in "the power of discriminating between different kinds of stimuli, irrespective of their relative degrees of mechanical intensity, coupled with the power of performing adaptive movements suited to the results of such

crimination." These two powers or faculties are seen in the actions of the Amœba; when their elaboration has proceeded to a certain extent, they begin gradually to become associated with feeling, "when they are fully so associated, the terms choice and purpose become to them respectively appropriate." Then follow chapters on consciousness, sensation, pleasures and pains, memory and association of ideas, perception and imagination. Six chapters are devoted to the consideration of instinct; chapter XIX is upon reason, and the last one, the twentieth, relates to animal emotions, and ends with a summary of intellectual faculties.

Dr. Romanes' views as to the comparative standing of animals in the intellectual scale are interesting, and we shall reproduce them hereafter. The essay by Mr. Darwin was one omitted from his Origin of Species, but will still be read with interest.

Do Labrador Dogs Bark?—In his Mental Evolution in Animals, Romanes remarks as follows (Appleton's edition, p. 250), regarding the barking of dogs in Labrador: "Lastly, it is now well known that the dogs of Labrador are silent as to barking." I find the following notes in my journal of a summer spent at Caribou island, Straits of Belle Isle, on the Labrador coast in 1860. "Some of the Esquimaux dogs are full-blooded, others are quarter, others half-Newfoundland. They keep up a constant howling. They are savage beasts. One without any provocation leaped up and bit a man twice in his hand, and very badly lacerated the under side of his arm." I cannot now remember that these dogs actually barked, but they were often heard to howl and were noisy creatures. In 1864, at Chateau bay, I heard the Newfoundland dogs on the vessels in the harbor barking. At Hopedale, the Eskimo dogs of the Eskimo of this settlement were thus characterized by Rev. Mr. Wasson in an article entitled "Ice and Esquimaux" in the *Atlantic Monthly* for April, 1865, p. 442, "Prick-eared Esquimaux dogs huddle, sneak, bark, and snarl around, with a free fight now and then, in which they all fall upon the one that is getting the worst of it."—*A. S. Packard.*

How a Bear Catches Fish.—I came suddenly upon a very large bear in a thick swamp, lying upon a large hollow log across a brook, fishing; and he was so much interested in his sport that he did not notice me until I had approached very near him, so that I could see exactly how he baited his hook and played his fish. He fished in this wise: There was a large hole through the log on which he lay, and he thrust his forearm through the hole and held his open paw in the water and waited for the fish to gather around and into it, and when filled he clutched his fist and brought up a handful of fish, and sat and ate them with great gusto; then down with the paw again, and so on. The brook was fairly alive with little trout and red-sided suckers, and some black suckers. He did not eat their heads. There was quite a pile of

them on the log. I suppose the oil in his paw attracted the fish and baited them even better than a fly hook, and his toe nails were his hooks, and sharp ones, too, and once grabbed the fish were sure to stay. They also catch frogs in these forest brooks, and drink of the pure water in hot summer days, and love to lie and wallow in the muddy swamps as well as our pigs in the mire. They often cross narrow places in lakes by swimming, and also rivers, and seem to love to take a turn in the water. I once saw one swimming from the mainland to the big island in Moosemaguntic lake, with just a streak of his back out of the water, looking like a dog moving along. Sometimes you see only their heads out of water; at other times half their bodies are to be seen. We account for this difference by condition. If fat, the grease helps buoy them up; if lean they sink lower in the water.—*Lewiston Journal.*

CUNNING AS A FOX.—The term "cunning as a fox" is by no means an ill-jointed figure of speech. Those who know best the habits of the fox are the most ready to accord to him the well-earned epithet "wily reynard." Not only is he careful of his own reputation and life, but he has a sort of a masonic solicitude for all of his craft. Two incidents, as related by eye-witnesses, will serve well to illustrate this.

Near the boyhood home of one of the writer's old college professors there was a high hill. Its rocky sides were covered with small trees and bushes. Here and there were fissures and small caves, occupied in earlier days by bears and other animals. The larger animals had all retired before the tide of civilization to more desolate solitudes. One old fox seemed to hold undisputed sway of the wily throne. On a smooth surface of the rock near the summit she would remain for hours planning her campaigns and nightly raids on neighboring farmyards, while her young gamboled about her. From her outlook on the hill she could plainly discern the fowl in the yard of our friend, who lived under the shadow of her home, but her cunning (or reason shall I call it?) would not allow the thought of molesting them. She seemed to well understand that she and her young could be seen by the family, hence she reasoned that if fowl disappeared from the yard the theft would be charged upon her, and her life would be sought.

Whatever her mental processes, she was never known to molest the farmyards nearest her retreat, but would often go miles from her home and there make havoc at the expense of some poor farmer. Her cunning enabled her to surely retain her home and prolong her days.

Another incident will show the solicitude that foxes have one for another. In Northwestern Maine there lives an old man who has become an expert trapper. One of his chief delights is to distance any other man in the number of foxes captured. While

on a vacation last season I chanced one day to fall in with this famous trapper, and had from his lips the following: "I became satisfied years ago that foxes often helped their fellows out of trouble. Not long ago I went out as usual in late autumn and set some traps for foxes. Sickness called me away from home, so that I did not get an opportunity to visit my traps for more than a week. In the meantime there had been a light fall of snow. When I had a leisure half day I shouldered my gun and went out to see what the sport was. My traps were all unmolested except one, that was nowhere to be found. I began to circulate around the place where it had been, taking a wider and wider sweep every time. At length, about a quarter of a mile distant from where it had been placed, in a dense piece of woods, I found my missing trap and a fox in it, fast by the leg. The old fellow was remarkably fresh and active, although he had been in the trap apparently for some days. The snow about him was well trodden down, and lying all around him, within in his reach, were an abundance of dead mice. If his fox friends could not release the captive, they were determined that he should not starve."—*B. S. Rideout, in Forest and Stream, June 26th, 1884.*

ANTHROPOLOGY.[1]

ANTHROPOLOGY IN FRANCE.—Dr. E. T. Hamy, curator of ethnology in the National Museum at Paris, has sent us several brochures, of which he is the author, and whose contents will be briefly noticed:

La croix de Teotihuacan, Mém. lu a l'Acad. des Inscriptions et Belles Lettres, Nov., 1882." Paris, E. Leroux, 23 p. This pamphlet describes two cruciform figures exhumed by M. Charnay in 1880, at Teotihuacan, north of the San Juan river and west of the avenue leading to the palace of the moon. After giving a comprehensive sketch of Spanish authorities upon the sculptured crosses of Mexico, Dr. Hamy defends the opinion that the Mexican crosses in question are the symbols of Tlaloc, god of rain and storm, and of the mountain. Other types of crosses are derived from the tree, the serpent, or from fancy. The transfer of the cross symbol from Tlaloc to Quetzalcoatl is explained in the closing chapter.

Note sur les Figures et les Inscriptions gravées dans la roche a el Hadj-Memoun, near Figuig. Paris, E. Leroux, p. 11.

Note sur une Inscription Chronographique de la fin de la période Aztèque appartenant au Musée du Trocadéro. Paris, E. Leroux, 1883, p. 14. This brochure is devoted to the description of a tablet of polished obsidian, 5 x 16 x 21 cm., collected by M. Pinart, and bearing a chronographic inscription, which Dr. Hamy concludes to be December 9, 1483, the date of the commencement of the great teocalli of Mexico.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

Quelques Observations sur la distribution geographique des Opatas, des Tarahumaras et des Pimas, survies d'une note sur la Toponymie Tarasque (Bull. Soc. d'Anthrop., Nov. 1883). Paris, A. Hennuyer, 1884, p. 11. This pamphlet is illustrated with a map, and confirms the opinions of the linguists as to the relationship of the Opatas and Tarahumaras, but not with reference to the Pimas, Cahitas, and Tépéhuanes.

Commentaire sur un Bas-Relief Aztèque de la Collection Uhde. Paris, E. Leroux. Plate v, Monuments anciens du Mexique represents a bas-relief in hard rock, brought by Uhde from Anahuac and copied by Waldeck. M. Hamy has analyzed the costume carefully and decides the sculpture to represent a priest of Tlaloc performing some ceremony.

RACES OF THE PHILIPPINES.—Dr. Montano, who has made a voyage to the Philippines, gives the following classification of the races in the Bull. Soc. d'Anthrop. Paris, VII, 3 ser., p. 51:

Race.	*Local name.*		*Habitat.*	*Number.*
Negrito	A. Negrito, pure		Balaan province, Luzon	?
	B. Mamanua "		Lake Maïnit, N. E. of Mindanao	300–400
	C. Negrito, mixed		Near Tiwi, Albay prov., S. E. of Luzon	100?
Malays	D. Manthra	Negrito blood predominat'g		
	E. Knabuï		Forests N. and E. of Malacca	?
	F. Udaï			
	G. Jakun			?
	H. Aetas		Forest of Camarines province, Luzon	
	I. Bicol	Chinese bl'd predomina'g	Albay prov., Camarines N. & S., part of Tabayas (Luzon)	350,000
	J. Tagaloc		Manilla and center of Luzon	1,200,000
	K. Bisaya		Bisaya Is., and coast of Mindanao	2,5000,000
	L. Moro, trace of Arabic blood		Soulou archipel. and Id.	10,000 for Soulou Id.
	M. Moro	Mixed Indonesian	Davao gulf, S. E. of Mindanao	?
	N. Kalagan			
	O. Buled Ipih		Sagalind r. and Kinobatangan, N. E. of Borneo	1000
Indo-Polynesians	P. Samal		Samal Is., Davao gulf	50,000?
	Q. Bagobo		S. and E. of Apo volcano, Davao gulf	
	R. Guianga		id.	
	S. Aetas		N. W. of Apo	
	T. Tagascaolo		E. of Davao gulf	
	U. Tagabawa		N. of Davao gulf	
	V. Manobo		Davao gulf, basin of the Ajusan, peninsula of Surigao	
	X. Mandaya		Sahug basin, E. coast of Mindanao	
	Y. Bilan		W. of Davao gulf	

In addition to the foregoing table Dr. Montano gives extended tables of measures upon the living and of crania.

PSYCHICAL RESEARCH.—In the year 1883 was organized in London the Society for Psychical Research, Professor Henry Sedgwick being the first president. The society's published proceedings, part v, having appeared in April of this year. Volume I, contains the following papers:

Address of the president at the first general meeting.
First report of the committee on thought-reading, with notes by Professor Balfour Stewart, Rev. A. M. Creery, Professor W. F. Barrett.
First report of the committee on haunted houses.
On clairvoyance. By G. Wyld.
Second report on thought-transference.
Third report on thought-transference.
Abnormal conditions of the mind. Professor W. F. Barrett.
Second report of committee on mesmerism.
Experiments in thought-transference at Liverpool. By Malcolm Guthrie and James Berchall.
Note on muscle-reading.
On dreaming and allied states. A circular letter.

In part v the investigations upon mesmerism and thought transference are continued. Professor Barrett also writes on the existence of a "magnetic sense," and Mr. Gurney on hypnotism. The most of the number is occupied with inquiries respecting the divining rod.

OKADAIRA SHELL MOUND.—To the courtesy of H. Kato, president, we are indebted for a pamphlet of seven pages and eleven folded plates, bearing the title "Okadaira Shell Mound" at Hitachi, being an appendix to Memoir, vol. I, part I, of the Science Department, Tokio Daigaku (University of Tokio). By I. Iijima and C. Sasaki, students in biology. Tokio: Tokio Daigaku, 2543 (1883). Hitachi is about thirty miles from Tokio, and upon the banks of the lakes and other water courses of the vicinity are shell mounds rich in ancient remains. The readers of the NATURALIST will recall the beautiful volume which appeared some time since on a similar subject inspired and partly written by Professor E. S. Morse, to whom the authors of the present monograph acknowledge their obligation. The objects found in the Okadaira mound were cooking vessels, hand vessels, bowls, pots, cups, and fragments, all of pottery; axes, celts, wrought pumice, and pit-stones; handles and prongs of horn and antler; bone of deer. The pottery is of rough material and some of the shapes are new, but one who has seen a great deal of our aboriginal pottery will be struck with the great similarity of paste and ornament.

PHYSIOLOGICAL INQUIRIES.—The committee of the Paris Anthropological Society have issued an eight page pamphlet, entitled, Projet de Questionnaire d'Anthropologie Physiologique, which, in brief, contains the following inquiries:

1. *General.*—Name, age, nationality, birthplace, profession, religion, civil condition.

2. *Physical.*—Height, weight, color of hair and eyes, temperament, alimentation (amount, regularity, nature, alcohol, decoctions,

smoking), senses (length of vision, endurance, hearing, smell, taste), sleep (hours, profundity, dreaming), muscular activity (walking, manly sports, handedness, voice, health, maladies, infirmities, deformities), hereditary resemblances (to which progenitor or ancestor most marked?).

3. *Psychic characters.*—Disposition (sad or gay, calm or violent, constant or changeable, energetic or irresolute, penchants, religious habit, literary taste, aptitude, music design, mathematics, poetry, elocution), memory (strength, peculiarities, intellectual endurance, manner of doing intellectual work, daily occupations), hereditary resemblances (to what relative degree of transmission).

4a. *Heredity Descendant.*—Name of wife, age, birthplace, date of marriage, death, peculiar maladies, fatal malady, color of eyes and hair, height, temperament, physical and psychical aptitudes, number of children, and for each the age, sex, color of eyes and hair, date of death, chief diseases, fatal disease, character and temperament, memory, mental aptitudes, character, like which parent or ancestor or relative, and in what particulars.

4b. *Heredity Ascendant.*—Father, mother, grandparents and great grandparents, uncles, aunts, great uncles and great aunts.

4c. *Heredity collateral.*—Brothers and sisters, date and place of birth, height, color of eyes and hair, profession, temperament, physical and psychical aptitudes, intelligence, principal maladies, fatal malady. For each characteristic determine whether there is any physical or psychical resemblance to any ancestor or relative.

It seems to the editor of these notes that nothing is more desirable at this time than a laborious effort to place comparative human physiology and psychology on a firm basis. A scheme like the one presented by the Paris Anthropological Society, if vigorously pushed will soon show its own defects. One serious difficulty will be to get persons to answer the questions, some of which may be deemed impertinent.

MICROSCOPY AND HISTOLOGY.[1]

Mr. Iijima's Methods of Preparing Planarians and their Eggs.[2]—In the preparation of Planarians for histological study, Mr. Iijima recommends corrosive sublimate as the only good preservative agent. The worms are placed in a shallow plate, *without water*, and a saturated solution of corrosive sublimate, heated almost to boiling, is poured over them. In this way they are killed so quickly that they do not have time to contract. They are left thirty minutes or less in the sublimate; then placed in water for an hour or more. The water should be changed several times, in order to remove all of the sublimate; otherwise it forms needle like crystals, which impair or ruin the preparation. Three

[1] Edited by Dr. C. O. Whitman, Mus. Comparative Zoology, Cambridge, Mass.

[2] "Entwicklungsgeschichte der Süsswasser-Dendrocœlen." Zeitschr. f. wiss. Zoologie, XL, p. 359, 1884.

grades of alcohol ("weak, strong, and absolute") are used in hardening, in each of which the object should be left at least forty-eight hours before staining. Borax-carmine (probably the alcoholic solution) is recommended as a staining agent; a dilute solution is used in preference to the full strength, and allowed to act from three to four days.

For preservation as museum specimens, they are killed with strong nitric acid (about fifty per cent), in which they die fully extended.

Preparation of the Ova.—The egg-capsules of fresh-water Planarians are generally attached to water-plants by means of a white secretion. The ova are very small and few in number, and are scattered among an immense number of yolk-cells. The ova are completely naked, and a little smaller than the yolk-cells, and are not easily isolated. When cleavage begins, a large number of yolk-cells surround the ovum, and form with it a mass large enough to be seen with the naked eye. Mr. Iijima adopts the following mode of isolation and preparation: By the aid of two sharp dissecting needles, the egg-capsule is opened on an object-slide in dilute acetic acid (two per cent). The contents flow out, and the empty capsule is then removed. The slide is next shaken in order to isolate the ova so far as possible from the yolk-cells. This process detaches many of the yolk-cells, but not all; each ovum will still have yolk-cells adhering to it, and will now appear to the naked eye as a minute white mass. A cover-glass supported by wax feet, or by slips of paper is now placed over them. After about thirty minutes the acetic acid is carefully removed by the aid of small pieces of blotting paper placed at one side of the cover, and replaced by alcohol (seventy per cent). The withdrawal of the acetic acid must be as slow as possible, otherwise the ova will be lost. After an hour the alcohol is replaced by a stronger grade (ninety per cent), in which the ova should remain two hours. Finally, the alcohol is replaced by a mixture of glycerine and water in equal parts, and this in turn by pure glycerine. The preparation is now complete, and the cover-glass may be fixed in the usual way by means of lac.

In order to obtain sections of embryos which are too small to be treated individually, the contents of the capsule may be hardened in toto in chromic acid (one per cent), which renders them less brittle than corrosive sublimate.

The changes which take place in the ovum initiatory to cleavage are very difficult to trace, as they are generally completed before the cocoon is laid. In some cases ova were found in fresh-laid capsules, which showed the germinal vesicle still unchanged; others were found to have two nuclei, supposed to be derivatives from the first cleavage-nucleus. This stage of two nuclei was also found in some cocoons taken directly from the penial sheath, in which the cocoon formation takes place. It is therefore not quite certain when fecundation takes place, whether in the cocoon or before its formation.

THE CONNECTIVE SUBSTANCE IN THE HIRUDINEA.—The anatomy of the Hirudinea has been treated monographically by Mr. Bourne. The following remarks on the connective substance are taken from his paper.[1]

The amount of this tissue which is developed is in direct proportion to the "limpness" of the leech. Clepsine and Nephelis have very little of this tissue, and are consequently relatively firm and rigid to the touch while living. Hæmopis and Aulostoma present the other extreme, remaining flabby or "limp" in all states of muscular contraction; while Hirudo, Trocheta, and Pontobdella present an intermediate condition.

The connective substance consists of a hyaline, jelly-like mass, interspersed with cells. The intercellular matrix is probably developed by ectoplastic modification of the cells lying in it. The cells themselves undergo various modifications which take place simultaneously, and to a certain extent overlap one another. Four principal lines of modification are mentioned.

1. *Entoplastic metamorphosis.*—Vacuolated cells and fat cells. Vacuolation is brought about by the formation of droplets of a semi-fluid substance, which give the cell a reticulate appearance, resembling mammalian areolar tissue. Fat accumulates in certain cells in small globules, which may remain separate or run together, and form a large globule. The fat-cells do not occur in the Gnathobdellidæ.

2. *Ectoplastic metamorphosis.*—Elongated or branched connective tissue cells occur in all the Hirudinea. It is the processes of these cells that form the fibers which run in all directions through the connective matrix.

3. *Ect-entoplastic metamorphosis.*—The cells develop pigment. In Pontobdella, Clepsine, Piscicola, and Branchellion these cells take no part in forming a vascular system, as they do in the medicinal leech, and closely allied genera. The development of the vascularized cells (botryoidal tissue, vaso-fibrous tissue), may be studied to advantage in Aulostoma. "In the connective tissue in the central region of the body there are numerous rounded corpuscles which appear to be, on the one hand, elongating, forming branched corpuscles, and on the other, to be developing pigment, arranging themselves in rows. A metamorphosis of a portion of their substance forms channels, which afterwards come into communication with other similar channels, and with the closed vascular system on the one hand, and with the sinus system on the other, forming 'botryoidal tissue.'"

The nephridial funnels in Nephelis and Trocheta are lodged in vascular dilatations of the botryoidal tissue. The "cutaneous network" of the vascular system in Hirudo is formed from the same tissue.

In regard to the "vaso-fibrous" tissue, Mr. Bourne says, "I

[1] A. G. Bourne. Contributions to the Anatomy of the Hirudinea. Quart. Journ. Mic. Sci., XXIV, July, 1884, pp. 440.

would suggest, interpreting my own and Professor Lankester's observations, that capillaries of the botryoidal tissue become converted into capillaries of the 'vaso-fibrous' tissue."

The capillaries upon the gastro-ileal portion of the alimentary canal are not derived from botryoidal tissue, but are probably formed by vacuolation of primitive connective-tissue cells.

Cœlomic and Vascular Spaces.—The contractile vacuoles of Protozoa, the ducts in nephridial cells, the newly developed vertebrate capillary, and all such intracellular spaces, are formed by metamorphosis of the cells themselves, and are thus distinct from cœlomic spaces. The formation of intracellular spaces may be distinguished as "*endocytic cœlosis*;" and the formation of intercellular spaces as "*paracytic cœlosis*."

Sensory Cells.—Mr. Bourne has traced the connection of the nerve with elongated cells, the bodies of which lie beneath the epidermal layer. He has overlooked the existence of certain peculiar cells, which are probably sensory, as I have shown elsewhere. These sensory cells lie completely beneath the epidermis, and are precisely like those found in the eye.

Mr. Bourne regards the small papillæ, which have a regular segmental arrangement in the leech, as tactile organs, and in this agrees with Leydig. In speaking of the eyes as "derivatives" of these papillæ, Mr. Bourne might have given me credit for calling his attention to this point.—*C. O. W.*

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SCIENTIFIC NEWS.

—On Tuesday last, the 2d inst., a meeting was held in the lecture room of the Zoölogical Department, British Museum, at which Dr. Coues was invited to attend, in order to explain his views and those of his compatriots on the question of nomenclature.

The chair was taken by Professor Flower, F.R.S., and amongst the speakers were the following, in the order named: Mr. R. B. Sharpe, who opened the proceedings by reading a paper "On the expediency or otherwise, of adopting a trinomial nomenclature in zoölogy;" Mr. Seebohm, who read a second paper on the subject; Dr. Elliott Coues, who explained the system advocated, and its application as proposed by him; Dr. Günther, F.R.S., who approved the scheme conditionally; Mr. P. L. Sclater, F.R.S., who pointed out that the method was not a new one, but thought it deserving of adoption by zoölogists, provided the limits of its application were properly defined; Mr. Blanford, F.R.S.; Professor F. J. Bell; Mr. Kirby; Lord Walsingham; Dr. Sharp; Dr. Woodward, F.R.S.; Mr. H. T. Wharton; Mr. Howard Saunders; Mr. J. E. Harting, and Dr. Traquair, F.R.S.

Various difficulties in the way of adopting a trinomial nomenclature were pointed out by different speakers; but, on the whole, the majority appeared inclined to a favorable consideration of the

scheme, with a view to its adoption with certain limitations. Dr. Traquair, Dr. Sharp, Mr. Blanford, and Mr. J. E. Harting spoke strongly against the proposed change, declaring themselves satisfied with the binomial system, which recommended itself by its extreme simplicity, and which in practice had been found to answer well enough by workers in all classes of the animal kingdom from the days of Linnæus to the present time. On bringing the proceedings to a close, the chairman (Professor Flower) said he hoped that Dr. Elliott Coues was satisfied with the way in which his views had been received. Although there were some uncompromising binomialists present, many had declared themselves what might be termed "limited trinomialists," and some appeared to go as far even as Dr. Coues himself. In nature, distinctly defined species undoubtedly existed in great numbers, owing to extinction of intermediate forms, and for these the binomial system offered all that was needed in defining them. On the other hand, there were numbers of cases in the actual state of the earth, and far more being constantly revealed to us by the discoveries of palæontology (and nowhere so rapidly as in America), where the infinite graduations defied the discrimination of a binomial system.—*From the Field.*

— The Newport (R. I.) Natural History Society, which was organized about two years ago, issued in July its proceedings, forming a brochure of forty-five pages, illustrated by four plates. Mr. J. Nelson Dale gives an account of the geology of the tract known as Paradise, accompanied by two excellent plates; he also prints remarks, with a plate, on some of the evidences of geological disturbance in the vicinity of Newport. Rev. C. F. Clark enumerates the coal plants of Rhode Island. Mr. Bayley Willis describes Mt. Tacoma in Washington Territory, giving the best account of this mountain which we have yet met with; it is illustrated by an artotype from a sketch made by the author. Mr. Willis notes the presence of ocean terraces about 1600 feet above the present sea level; and remarks "there are certainly eight glaciers on Mt. Tacoma, perhaps ten or twelve; I do not know exactly how many there may be on the south-east; but, beginning on the north-east and counting westward, there are the glaciers of the White and Carbon rivers, the two of the north fork of the Puyallup, the one of the south fork, that of the Nisqually and probably two of the Cowlitz river." Besides other papers, Mr. A. D. Wilson describes a trip through north-western Wyoming; and valuable contributions to local ornithology are Dr. Wm. C. Rives' Birds of Newport, and Col. J. H. Powel's List of birds shot near Newport.

— Professor C. W. Hall's interesting address on "The Physiographic Conditions of Minnesota Agriculture," is another article among others of our modern school of scientific agriculture which tends to show the intimate connection between the natural sciences

and agriculture, and evincing the progress making in this country towards laying a scientific basis of agriculture. The subjects treated are the following: Minnesota, the center of the continent; land and water, arable, prairie and forest areas; forest trees, river basins, altitude of rivers, towns, lakes, their kinds and distribution; drift, soils, rainfall, temperature and climate, and consequent conditions of successful farming in the State. To have subjects like these brought to the attention of the younger and more active farmers of any State, is to immeasurably advance their interests and to increase the attractions of a farmer's life, enlarging the scope of his powers of observation.

— At a banquet lately given by a number of anthropologists to M. G. de Mortillet, the hall was decorated, says *Nature*, with a life-size picture of a prehistoric Gaul, executed according to the last discoveries of M. de Mortillet. The man is represented as having no hair on his body; his arms are very long and muscles very powerful, but his toes are not opposable, although they could be used in climbing the trees of the primitive forest. His jaw is strongly prognathous, but not at all equal to that of an anthropoid ape. His chest is strongly compressed laterally, and his abdomen prominent. The skin is not negroid, but of our present color. The expression of the face is in intelligence on a level with that of an Australian. In the Paris *salon* also is a large picture representing a prehistoric tribe preparing in their cave to feast upon a cave bear which has been killed with their stone implements.

— The sixth volume of the Bulletin of the Philosophical Society of Washington, just issued, contains the minutes of the Society for 1883, and of the mathematical section from its organization on March 29 to the close of the year. Among the papers are the annual address of the president, J. W. Powell, on "The three methods of evolution," and abstracts of communications by C. E. Dalton on the geology of the Hawaiian islands and "The volcanic problem stated;" by J. W. Chickering on the thermal belts of North Carolina; the geology of Hatteras, by W. C. Kerr; ore deposits by displacement, by S. F. Emmons; glaciation in Alaska, by W. H. Dall; the drainage system and loess of eastern Iowa, by W. J. McGee; the Cambrian system in the United States and Canada, by C. D. Wolcott.

— The twelfth annual Report of the Zoölogical Society of Philadelphia, shows that our foremost garden of animals is not less prosperous than in former years. The list of additions during the year is a full one, as is the list of animals bred in the garden during the year; among them a hybrid wallaby, a dingo, a zebra, an onyx, a Bactrian camel, besides a number of native animals. Among the more notable additions, were six sea elephants, and a chamois.

— Mr. Arthur F. Gray has compiled a complete list of the scientific papers of Thomas Bland, F.G.S., from 1852 to 188 printed at Salem, Mass. The entries are seventy-two in numbe and Mr. Gray acknowledges the material aid of Mr. Bland in the preparation of the list. It is to be hoped that the labors of one of our most distinguished conchologists, may go on and necessitate the issue of a future addendum, as long and as creditable as the original list itself.

— The fifteenth annual report of the American Museum of Natural History shows increased money receipts, increased number of visitors, with valuable additions to the collections of monkeys and apes, including the gorilla and chimpanzee, and fifty other monkeys from all parts of the world. Progress in the ornithological, entomological, conchological as well as archæological departments is reported.

— Professor Flower has the title of "Director" of the Natural History Museum instead of "Superintendent," which was Sir R. Owen's official designation. The staff will consist of four keepers of departments (botany, geology, mineralogy, zoology), two assistant keepers, eleven first-class and fourteen second-class assistants, a staff which would appear to be ample for the work to be done.

— The fourth number of the Bulletin of the Chicago Academy of Sciences is devoted to a report by H. A. Johnson and B. W. Thomas on the microscopic organisms in the boulder clays of Chicago and vicinity. These consist of rhizopods, diatoms, Foraminifera, including three forms identified by Professor Leidy, who states that these forms are still living in the Atlantic ocean.

— In another direction equally useful, though different in character, is Mr. E. Haworth's contribution to the geology of the lead and zinc mining district of Cherokee county, Kansas, presented to the Kansas State University, with an application for the degree of master of science; the author being a resident of Iowa.

— The question as to the authorship of The Vestiges of Creation is finally settled, as a new addition of the famous work is advertised by W. and R. Chambers, with an introduction admitting its authorship by Robert Chambers, and revealing the circumstances under which the book was written.

— It has been reported that Professor D. S. Jordan, will remove to London to take charge of some part of the ichthyological collection of the British Museum. Professor Jordan authorizes us to state that the report is untrue. We congratulate our friends that this is the fact.

— The Triennial Congress of Geologists was to have been held in Berlin on September 25th, of the present year. It has been postponed to the corresponding time next year on account of the invasion of the cholera in southern Europe.

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RECENT STUDIES OF THE SPADE-FOOT TOAD.

BY CHARLES C. ABBOTT, M.D.

IN a sink-hole in a dry upland field near Trenton, New Jersey, on April 10, 1884, there suddenly appeared a large colony of hermit spade-foot toads (*Scaphiopus holbrooki*), which, by their remarkable cries, attracted the attention of every one passing by. So unlike the cries of any other of our batrachians were their utterances, that all who heard them were attracted to the spot, and wondered, when they saw the animals, that so great a volume of sound could issue from so small an animal. One need not wonder, however, on this point if they will but examine the development of the animal's vocal cords. The machinery for producing sounds equal to an ordinary steam whistle are apparently contained in the throat of this rare and curious batrachian. Holbrook, in his diagnosis of the genus Scaphiopus, refers to the "sub-gular vocal sac" of the males; but it must not be inferred that the females are voiceless. That they are not so noisy is probable, but occasion requiring, they can readily make themselves heard.

Scaphiopus holbrooki.

These spade-foots remained in the shallow waters of this sink-

hole until April 15, when the weather becoming considerably cooler, they as suddenly disappeared as they had come. In May, 1874, these toads appeared in like manner in the same locality, remained but a few days and were gone. In the intervening ten years not a specimen was seen or heard, although careful search, annually, was made. I supposed, when they appeared in April of the present year, that they spawned previous to their sudden disappearance, but neglected to investigate the matter in consequence of a press of work in other lines of investigation. The spade-foot toads were soon forgotten. The wealth of bird life that came trooping in from the South during May, and their subsequent nesting, occupied my thoughts and were the prominent objects sought during my daily rambles.

It was not long, however, before the spade-foots again became the prominent feature of the fauna of the neighborhood. During the night of June 25–26 a violent north-east storm arose, and rain fell in torrents. The sink-hole, which for weeks had been nearly dry, was again flooded, and on the afternoon of the 26th was literally alive with these rare toads. Sitting upon every projecting stick or tuft of grass, or swimming with their heads above the surface of the water, were spade-foots by the hundred, and every one apparently uttering those shrill, ear-piercing groans that only these batrachians can utter. Not only during the day but all night their cries were kept up. The following day there was no abatement, but during the night the sound decreased. On the morning of the 28th not an individual was to be seen or heard.

During this brief interval these animals spawned, the eggs being attached to blades of grass and slender twigs. These eggs hatched on the 2d of July and a large series were gathered a week later.

To return to the eggs. During the time that intervened from the laying of the eggs until I gathered specimens of the tadpoles, there occurred four moderately heavy showers, so that the water in the sink-hole at no time disappeared, but was much below the level that it reached during the protracted rain-fall of June 26. Very much, therefore, of the spawn that was laid was high and dry for from two to four days before hatching, and I suppose was destroyed.

On the evening of July 9 I found the water in the sink-hole

confined to a few very shallow pools of limited area, and in these pools were a few hundreds of Scaphiopus tadpoles. In comparison with the abundance of eggs seen June 26, and of young seen a week later, it is evident that a large portion of the eggs were destroyed and a vast number of very young tadpoles were killed by the soaking away of the water.

I have never known any like disparity between the eggs of frogs or common toads and the young in the tadpole state; and it is at once very evident that if the spade-foot toads habitually or usually deposit their eggs in temporary pools, then we have an obvious reason for the positive rarity of the animal, as apparently it is the rule, rather than the exception, for the egg to be destroyed or the young perish.

The tadpoles gathered July 9, which were then seven days old, were curious creatures. At this time the hind legs were well developed, although small, and did not interfere with the animal's natatorial locomotion. The bodies of these young Scaphiopi were short, stout and oval, and, when viewed in the water, deep velvety black; but when closely examined it was found that the two irregularly parallel yellow dorsal stripes, that are so prominent a feature in the coloration of the adult male, were plainly discernible.

The movements of these tadpoles were not different from that of the young frogs and toads in this stage of their existence. Those that I had in an aquarium moved in companies as though following a leader, and occasionally one would drop out of the ranks, come quickly to the surface, eject a bubble of air, and dive again quickly to the bottom of the tank. Like all tadpoles they had enormous appetites, and when fed with bits of raw meat quickly attached their sucking mouths to the food offered, and did not remove it, I think, while a particle of blood remained in the mass.

A week later, July 16, the majority of these tadpoles had acquired their front legs, and the tail had perceptibly diminished in size, but still was used by them when moving through the water. At this time, however, the movements of the animal are far less active than before or soon after, and for a few days, if exposed to the attacks of any enemies, would suffer far more than at any other period of their lives.

A very curious feature in the growth of these animals is now

to be noticed. Of the specimens I had under examination, in an aquarium, about five per cent did not progress beyond the condition in which all were in July 9. These "retarded" tadpoles proved to be voracious cannibals. They seized their more matured companions by their tails and legs, swallowing the member and thus sustaining their own lives at the expense of their fellows. They generally killed their victim in the course of twenty-four hours, and often in less time, and then promptly seized another. So bloodthirsty were these few "retarded" tadpoles that I was compelled to protect the lives of the little hoppers, their brethren, which now, in spite of stumps of tails, sat in frog-like fashion on their haunches, and were in all respects miniatures of the adult spade-foots that in April and June made night hideous with their unearthly cries.

Having tested several specimens, a few days previously, as to their ability to assume the land-life of adult Scaphiopi, by placing them upon damp sand, and finding that they throve fairly well, on the 25th of July I removed the water in the aquarium and put in earth to about an inch in depth, and very carefully smoothed the surface. Upon this the young spade-foots were placed, and in less than one minute many had commenced digging little burrows, into which they disappeared as the excavations deepened. In all respects these burrows were like those made by adult spade-foots, oval in outline, oblique in direction, and generally with a slight angle in the course. In twenty minutes all but two, of forty-four specimens, were below the surface of the earth stratum I had placed in the aquarium.

It now became monotonous in the extreme to watch them. Not a movement occurred that was other than might be expected of adult toads or frogs of any species.

I did not see them eat, but as only living food would now be accepted by them, it was simply because minute insect life did not come within reach; but while yet in the water these young spade-foots found some food, as shown by the examination of the stomachs and intestines of several specimens. Dr. A. C. Stokes kindly made this examination, at my request, and reported as follows: In the stomach of one was found fragments of a fly and of a small moth, and in the intestine a mass of sand grains cemented together by dark brown amorphous matter, with numerous rhizopods (Arcella) and several diatoms. In the stomach of another a species of Thrips, and a few diatoms in the intestine.

These two species had been thirty-six hours out of the water when the examination was made.

During this simple series of observations of young Scaphiopi in confinement, I watched also the development of those left in the sink-hole. The water there soon was confined to mere puddles concealed in the dead leaves, and before the young had their limbs fully developed the depth was nowhere sufficient to permit of swimming. Three days in advance of the maturing of my confined specimens, I saw, in the sink-hole, a few individuals which had fairly assumed the land-living, air-breathing stage of existence. Supposing that, like those I had at home, they would burrow in the earth *where they were*, I did not visit the locality from the 21st to the 31st of July, on which date I made an exhaustive but unsuccessful search for them. Not a trace of either young or adult could I discover. It cannot be said that they were overlooked. My search was too careful and comprehensive for this, and I believe that these spade-foots, both old and young, wander farther from their breeding grounds than is supposed, or else dig far deeper into the earth than a depth of six or eight inches, as stated by Holbrook and DeKay.

I have already referred to the wonderful noises made by these animals when they congregate in pools for the purpose of spawning. At no other time do they appear to be vocal, and the question naturally arises, why, when the animal leads a life that requires no such power except for two or three days in a year, should its utterances be far louder than any or all the frogs and toads of the same locality combined? Although the animal is strictly crepuscular and not diurnal, it could readily find a mate guided by sight, and the purpose of the deafening epithalamium is somewhat hard to determine. If it could be shown that they call to each other from far distant points, the difficulty would disappear, but this they are not known to do. Apparently it is not until they are congregated in some available pool that they sing, if singing it can be called. No words yet in use in our language can fairly describe their utterances, which, it may be presumed, are expressions of delight at meeting.

A word in conclusion with reference to the peculiar spur-like process which gives the common name to this batrachian. Holbrook describes it accurately as follows: "On the internal margin of the metatarsus is a horny spade-like process, containing a

bone, which moves by an imperfect joint: the breadth of the process is about a line and a half, its length one line; the cutting edge is jet black." Fig. 1 represents the left foot of an adult specimen, seen from beneath, and showing the "spade." It will also be noticed that the little toe terminates also in a horny knob, a fact which has hitherto, I believe, been overlooked.

Fig. 1.—Nat. size.

Fig. 2.—×10.

FIG. 1.—Inside of adult left foot, natural size. FIG. 2.—Left foot of young, showing spur at earliest stage of growth.

I have already mentioned how quickly the young hoppers dug little tunnels for themselves when placed upon the earth. At that early age the growth of the "spade" had commenced, as will be seen by the drawing, Fig. 2. This is now a white, soft, cartilaginous process, differing greatly from the same feature on an adult foot. It can scarcely be of use in digging, at this time, and so leads us to infer that the young choose more yielding earth and remain nearer the surface than do the adult spade-foots. In such a case the older the creature and better developed the spade, the deeper are the subterranean homes wherein they seem to remain so closely, and from which, moved by some common impulse, they mysteriously come forth, in multitudes, to startle the passer-by with their weird cries, and then as suddenly to disappear, no one knows where.

NOTICES OF SOME NEW PARASITIC INFUSORIA.

BY ALFRED C. STOKES, M.D.

WHILE making a microscopical examination of the intestinal and stomach contents of young spade-foot hermit toads (*Scaphiopus holbrooki*), whose life-history Dr. C. C. Abbott is studying, I observed two forms of apparently undescribed endoparasitic Infusoria so crowding the rectum that it seemed only a thin walled tube surrounding a semi-solid, writhing mass which, viewed with a low power objective, brought to mind the idea of a shimmering cloud of heated air, or a wavering flame of colorless fire, through which here and there glistened a yellow spark.

The rectum of toads and frogs has long been a kind of happy hunting ground for endoparasites, especially for the Opalinæ; but so far as I am aware only colorless species of the genus have been observed. In this instance, however, the yellow points within that living mass proved to be Opalinæ of a lemon-yellow tint. The periphery and, to a much less extent, the deeper portion of the endoplasm are tinged, the color, which appears to be a stain and not an aggregation of particles, being collected in a layer near the cuticular surface, with a quite sharply defined line of demarkation between the lower margin and the internal body-sarcode.

The infusorian is broadly ovate, soft and flexible and somewhat changeable in shape, assuming at will a subpyriform or subglobose figure. The surface is indented by obliquely disposed striæ which bear the long and fine vibratile cilia clothing the creature. Scattered through the endoplasm are numerous refringent corpuscles mingled with many larger spherical bodies having the aspect of vacuoles. The former may be portions of the nucleus, as that constituent is known to break into corpuscular parts with age, and to become scattered as the infusorian matures. Nothing else corresponding to an endoplast was observed, even after using reagents. There is no trace of a mouth. Nutriment is probably absorbed from the intestinal fluids in which the animalcule delights to live. The contractile vesicle is also absent.

Its numbers are not great; perhaps a dozen were noted in the contents of the rectum. Neither is it always to be found. Compared with its more numerous associates, however, this yellow creature is a giant among pygmies, and it rotates through the

mass with a carelessness as to results quite in keeping with its bulk. It measures from $\frac{1}{380}$ to $\frac{1}{350}$ inch in length.

On account of the color it may be named *Opalina flava*, and the following description, in connection with its habitat within the rectum of the rarest of our batrachians, will probably be sufficient for its identification. It is shown in Fig. 1 magnified about 235 diameters:

X235

FIG. 1.—*Opalina flava*, sp. nov.

Opalina flava, sp. nov.—Body ovate, inflated, often as long as broad, or subpyriform, widest and rounded posteriorly, the length once and one-half to twice the breadth; the right and left hand borders evenly rounded; striations of the cuticular surface obliquely disposed and bearing the long, fine, vibratile cilia: nuclei (?) numerous, small, scattered; sarcode enclosing many refractile corpuscles and larger spherical bodies apparently vacuolar; contractile vesicle none; parenchyma lemon-yellow, the color darkest near the periphery, where it is disposed in a layer, the central portion of the sarcode being comparatively colorless. Length, $\frac{1}{330}$ to $\frac{1}{350}$ inch. Habitat, the rectum of the spade-foot hermit toad, *Scaphiopus holbrooki*.

The intestinal fluid seemed thickened by the throng of bacteria, bacilli, vibriones and spirilla accompanying the Opalinæ; and associated with them was not only the undescribed flagellate zoöid to be referred to presently, but a large species of Opalina, which I have, after some hesitation, identified with *O. ranarum* Purk. Their appearance and structure are those of the latter, but the size is much less. They are quite active. As they pressed each other beneath the surface or forced each other upward, the aspect of the field of view was comically like a pool of furiously boiling soup with big dumplings bobbing about.

Associated with this crowd was a somewhat more interesting flagellate infusorian. It, in common with most endoparasites, is colorless, and very soft and flexible. Its structure is so different from all other creatures in so many particulars that a new genus is needed to receive it. In its habitat it seems restricted to the rectum. Very seldom, if ever, is it captured wandering into the upper intestine. Its form is more or less ovoid, usually tapering to a somewhat pointed anterior extremity, and its consistency seems scarcely greater than the white of an egg. The three anterior vibratile flagella, about equaling the body in length, are of extreme tenuity, their three-fold aspect appearing only after the most careful scrutiny of the weakened or dying infusorian. In the active animal their rapid motion suggests the existence of

cilia, or, when momentarily seen, they appear as a single filament.

Extending along the entire length of one lateral border is a narrow, rapidly undulating membrane, very readily mistaken for a spirally twisting flagellum. Its free edge seems to be thickened, and its line of insertion on the body has the appearance of a distinct filament or ridge. That this usually conspicuous line is not a flagellum is proved by its invariable adherence to the surface. It has never been observed to lift itself or to exhibit independent movement; it always follows the contortions of the body and always keeps the same relative position in reference to the margin of the undulating membrane. It is, however, very liable to be confounded with a long, thread-like filament which springs from the terminal margin of the membrane. This appendage, unique in its position, seems to have no individual freedom of motion, but follows and completes the undulations of the tissue to which it is attached, as the lash follows the brandished whip-stock. That it has no other connection with the body proper I am convinced, although it is as fine and as difficult to satisfactorily examine as are the three anteriorly inserted flagella.

The parenchyma is usually more or less vacuolar. It becomes conspicuously so when surrounded by water, the vesicles varying in size and often changing their position rapidly. A true pulsating vacuole is absent. The nucleus is also obscure. Occasionally a small refringent disc, usually structureless, rarely granular, is noticeable near the center of one lateral border, and may be the endoplast.

Longitudinally traversing the zoöid from the apex to the posterior extremity, where it conspicuously projects, is a flexible, somewhat curved and rod-like body, enlarged at its origin, thence of a constant width to the distal end where it becomes suddenly acuminate. The point of exit from the sarcode is well marked, the cuticular surface occasionally appearing to surround it for a short distance like a sheath. When the animal is immersed in pure water it becomes shortened and permanently fusiform, and this rod then protrudes an increased length which small protoplasmic drops often cover. What the function and constitution of this motionless and refringent structure may be, it is difficult to conjecture.

No oral aperture is visible. Very rarely a few small dark-

bordered granules are noticeable within the body, but if they ar of external origin their mode of entrance is unknown.

Although existing in such profusion I have observed the reproduction in but a single instance. The cause is probably th ease with which they lose their health in water. They are tena cious of life, however, individuals living for twenty-four hour within a rectum in a life-slide, but water does not agree wit them. Multiplication took place with amazing rapidity. A dr of sarcode separated from the posterior extremity of the body quickly followed by another, both immediately assuming a spher cal form and both almost immediately rupturing and with som force shooting out a zoöid less than one-fourth the parent's siz and with the undulating membrane less developed, but otherwis resembling it. Fission, encystment, rupture and escape were al accomplished in less than two seconds. I have witnessed this but once, as stated, yet before seeing it I had repeatedly observed an act whose significance I failed to appreciate until it had been examined in the reflected light of the completed process. It is that a portion of the posterior extremity of the animalcule fre quently becomes separated, but immediately un dergoes disintegration or diffluence, and proba bly represents an attempt at reproduction made incomplete by unpropitious surroundings. The multitudinous young are much smaller than the adults, more spindle-shaped and more active.

Fig. 2 represents the mature endoparasite magnified 1100 diameters.

FIG. 2.—*Exechlyga acuminata*, gen. et sp. nov.

EXECHLYGA (εξεχης, *projecting from*; λυγος, *a pliant rod*), gen. nov.—Animalcules free-swimming, soft and flexible, ovate; three long, subequal, vibratile flagella produced from the anterior extremity; an undulating membrane developed along one lateral border; a motionlesss rod-like body traversing the zoöid longitudinally and projecting beyond the posterior extremity; oral aperture none; contractile vesicle absent. Habits, endoparasitic.

Exechlyga acuminata, sp. nov.—Body ovate, widest and rounded posteriorly, tapering to the somewhat pointed anterior apex; length two and one-half to three times the width; parenchyma often vacuolar, colorless; anterior flagella three, as long as the body, subequal and fine; undulating membrane narrow, its margin apparently thickened, the line of insertion usually conspicuous, and its posterior border terminating in a fine filament subequal to the zoöid in length; internal rod-like body curved, anteriorly enlarged, the distal

extremity of the posteriorly projecting portion suddenly acuminate. Length of, body $\frac{1}{1505}$ inch. Habitat, the rectum of the spade-foot hermit toad, *Scaphiopus holbrooki*.

Another infusorian, which lives more or less in the light of the sky, but suffers and often dies when forced to leave its host, occurs not uncommonly as an ectoparasite on the social rotifer Megalotrocha. I have taken it in considerable numbers on colonies obtained from widely separated localities and at long intervals. This season the rotifers have seemed especially abundant and the colonies particularly luxuriant. The infusorian glides rapidly over the surface of the host, often passing from one individual to another, and running to the edge of the ciliary disc, whence a current from a neighboring rotifer occasionally sweeps it into the surrounding water. If carried so far beyond the influence of the currents that it fails to find its way back to the colony, it soon begins to show evidence of uncongenial surroundings. Its form changes, it becomes swollen, pale and ghostly, its cilia act irregularly and the creature speedily dies, the rotifers' cuticular secretions seeming necessary for its welfare.

The ectoparasite referred to belongs to Stein's Hypotricha and to Ehrenberg's genus Chilodon. It differs from the cosmopolitan *Chilodon cucullulus* (Mull.) Ehr., in form and size, in the absence of the sharply pointed anterior extremity or lip, in the greater curvature of the pharynx, in the course of the adoral channel, that of *C. cucullulus* being directed forward and outward from the pharyngeal orifice, and especially in its ectoparasitic habits. The convexity of the dorsal surface varies. In some individuals it is evenly rounded; in others conspicuously flattened and often traversed by irregularly transverse grooves or channels. The curvature of the pharyngeal armature is also variable.

When the parasite is gliding over the host's surface it is not possible to observe the manner of taking food. But individuals having been swept into the water and been brought back by the return current, have occasionally settled on the cover-glass in such a position that the process was apparent. When feeding from the side of a rotifer or from the retracted and rounded extremity, the anterior end becomes much narrowed and elongated, while the pharynx is protruded and closely applied to the surface which it infests.

Reproduction is by both transverse and longitudinal fission. In Fig. 3 is represented the ventral, and in Fig. 4 the lateral aspect magnified about 600 diameters. To designate the species it may appropriately bear the name of the host and be *Chilodon megalotrochæ.*

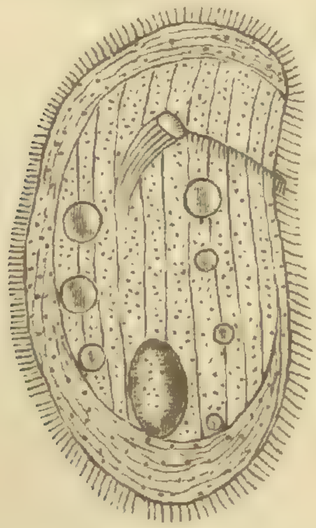

Fig. 3.

Fig. 4.

FIG. 3.—*Chilodon megalotrochæ*, n. sp, ventral aspect. × 600. FIG. 4.—*Chilodon megalotrochæ*, lateral aspect. × 600.

Chilodon megalotrochæ sp. nov.—Body soft, flexible, ovate, the length once to once and one-half the breadth, somewhat widest posteriorly; the anterior and posterior extremities rounded, the left hand border slightly concave near the anterior apex; lip short, obtuse, inconspicuously directed toward the left; dorsal surface convex, naked, the ventral one flat, finely striated and entirely clothed with short, vibratile cilia, those of the anterior extremity somewhat more conspicuous; the adoral groove shallow, directed backward and outward from the pharyngeal orifice, its cilia under insufficient amplification presenting the aspect of a single projecting seta; nucleus ovate, granular, mesially placed in the posterior body-half; pharyngeal armature more or less curved; contractile vesicles numerous, scattered. Length of body $\frac{1}{400}$ to $\frac{1}{350}$ inch. Habitat, ectoparasitic on the social rotifer Megalotrocha.

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GROWTH, ITS CONDITIONS AND VARIATIONS.

BY CHARLES MORRIS.

IN the story of organic life there is nothing more remarkable than the extraordinary diversity in size between mature animals and plants. The question may well be asked why, in one case, an animal is full grown on attaining the size of an ant, while another gains the bulk of an elephant or whale; and why the lowly moss fails to attain the size of its giant brother, the oak. It might be simply answered that this is a mere question of nutrition, some forms being better adapted to obtain food than others. But the question cannot be disposed of so

readily. Other elements than mere nutrition enter into the problem, and its full consideration requires a review of all the conditions of organic life.

As we ascend in the scale of life we find animals to be possessed of constantly more efficient food-taking organs. From the cilia of the Infusoria and the Sponges we pass to the Cœlenterate tentacles and thread cells, the sucking disks of the Cephalopoda, the pincers of the Crustacea, and the limbs and teeth of the Vertebrata, with numberless intermediate implements of capture. There is a like range of efficiency in the weapons of each sub-kingdom and class of animals. An Octopus, for instance, is a thousand fold more efficiently armed than an oyster, and a man than a mouse. There is a like variation in the rapidity of motion of various animals, some being completely sedentary, others exceedingly active. Their mental powers vary in like manner, from utter obtuseness to great quickness of intellect.

All these differences enter into the question of difference of size, yet they only partly suffice to solve the problem. Great diversity occurs between animals of equal organic efficiency, muscular activity and mental quickness. A rat, indeed, is superior in all these requisites to a cow or a hippopotamus, and a mouse is certainly a more highly organized animal than a whale. It has more efficient and better armed limbs, a greater variety of movements and diversity of habits, and probably superior mentality. In this latter respect, however, the ant is in advance of many massive vertebrates, yet it remains one of the smallest of its own class of insects, the largest of which are certainly not the shrewdest.

If we take a close survey of the animal kingdom, one interesting fact quickly appears, namely, that all the animals below man exist but for three purposes, to obtain food, to escape danger and to reproduce their kind. No other marked purpose in their lives can be seen. They rest and sleep to regain strength, they occasionally employ their excess vigor in play, and curiosity and imitation are now and then displayed, but only strongly in the monkey tribe. Yet the great purposes of their lives, and of lower man as well, are the three above named. Only in higher man do the faculties of curiosity and imitation unfold into the desire for knowledge, and the designed effort to attain advanced conditions, which are the basic principles of the higher mental

evolution. Through the persistent exercise of these faculties man, while retaining in strong measure the three life purposes of the lower animals, has added to them many others of a higher grade. But the faculties which have led to man's mental evolution exist only undeveloped or but slightly developed in the lower life kingdom, and the whole vigor of these lower creatures is given to the purposes named.

These purposes in reality may be reduced to two. Assault and defence are devoted to a single end, the preservation of individual life. Reproductive activity is devoted to another end, the preservation of race life. These two purposes are, to a considerable extent, in opposition. The animal that is efficient in either is apt to be deficient in the other. The one great object to be attained is life continuance. Any animal tribe that declines in both nutritive and reproductive powers dies out. Only those that are successful in one of these powers can hold their own in the life struggle. But it is simply impossible that any tribe can be markedly successful in both these directions, for two reasons. In the first place great reproductive powers interfere with success in food taking, by increasing the number of applicants for the food supply. It sets up a struggle for existence within the ranks of the tribe itself. In the second place there is a physiological opposition, a struggle for existence between the powers of the individual. Great activity in food getting reduces the reproductive energy. Great reproductive vigor exhausts the muscular and nervous strength. Thus no animal can possess superiority in both these directions, and to the extent that it succeeds in one direction, its powers must decline in the other.

This opposition is displayed throughout the whole range of the animal kingdom. As a general rule the smaller and the shorter lived the animal the greater its fecundity. But small size and short life indicate that its powers of obtaining nutriment are limited, or that its destruction by enemies is great. The continued existence of the tribe, in this case, can only be gained by prolific reproduction. Again, some animals have efficient food getting powers while in the larval state, as in the case of certain insect larvæ, while their nutritive advantages are greatly reduced in the mature state. In such cases we find the larvæ to feed and grow rapidly, while the imago scarcely feeds at all, but devotes all its powers to reproduction. But in the case of certain insects which

are well adapted to procure food in the mature stage, as in ants, the reproductive powers fail to develop at all, except in one or a few members of the tribe, while individual life may be continued for years.

The opposition between these two powers is clearly displayed in other cases. Wherever nutriment is abundant and easily obtainable individual life at once gains an advantage over race life. The reproductive period is retarded. But if nutriment become deficient reproduction is hastened. This has been fully proved by experiments on plants, which, if abundantly fed, grow profusely in leaves and branches, but delay flowering. But if subjected to a starvation process they flower early, and remain stunted individually. Instances of the same kind may be observed in animals, and as a rule deficient nutrition may be said to cause reduction of size and early reproductive activity, while abundant nutrition has the opposite effect.

In this regard an interesting conclusion may be drawn from a general survey of the conditions of animal life. Reproduction means the separation from the body of cells which are the epitome in structure of the whole organism. This separation bears a constantly decreasing relation to the bulk of the whole body as we ascend in the animal series. In the Protozoa the germ-cell takes the half of the body, or in some cases the whole of the body is converted into germs. In the Metazoa a lesser portion of the body is shed as germs. The proportion is great in the lower animals, in some cases extreme, but small in the higher classes, and very minute in the highest. The fact that the shedding of germs is hastened by deprivation of food suggests a reason for this difference. Every higher animal is in a certain sense a colony of coherent cell individuals. This coherence is an indication that they are favorably situated for nutrition. If food fails to come to them they will go to seek it. In other words, the offspring of the coherent cells will become wandering cells. This is very probably a constant effect of the growth of animals, since with every increase in bulk the ability to supply the whole mass of cells with food decreases. In consequence we may surmise that wandering cells are budded off by the fixed cells more abundantly as size increases, with the effect of checking the growth of the animal, and eventually of preventing any further increase in bulk.

At the same time the profuse existence of wandering cells is a necessary preliminary condition to reproduction. These cells, as the writer has already advanced in a former treatise,[1] conjoin and subdivide until from the union of cells, each of which possesses the structural peculiarities of only a minor portion of the organism, are produced cells containing the structural characteristics of the whole organism, and consequently suited to become the germs of new organisms.

Such is presumably the general character of animal life operations. The food-getting powers of Protozoa are very slight. Their cilia are inefficient organs, and only suited to the capture of very minute prey. As they increase in size their power of obtaining sufficient nutriment decreases. Hence division takes place and the offspring become wandering cells, since their chances in the life struggle are thus improved. With higher animals special conditions have rendered the colonial aggregation of cells advantageous, and cell-coherence becomes the rule. By combined effort each cell succeeds in obtaining more food than it could have done by its unaided efforts. But in every case as the size of the individual animal increases, its ability to satisfactorily supply all its hungry cells with food diminishes. The point at which the limit in this direction will be reached depends on the degree of efficiency in the food-taking organs, and also on the quantity of available food, more nutriment being requisite the greater the bulk of the animal.

When this limit is reached, individual life growth ceases. The organic powers remain stationary for a time and then deterioration sets in. This deterioration is apparently a necessary result in all organisms, arising from a gradual failure of the individual life powers, or from inimical organic processes which inevitably arise. That this is really the case, however, is not sure. It is by no means certain that an indefinite continuance of individual animal life might not be possible if the reproductive process were completely checked. It might reasonably be conjectured that if this were possible it would have occurred somewhere in the long range of animal development, during which such an extreme diversity of form and condition was produced. But such a race of animals would certainly be at a disadvantage in the life struggle. Its powers of continuous life must gradually succumb to

[1] AMERICAN NATURALIST, June, July, August, 1882.

starvation, accident, the violence of foes and all the external conditions which oppose individual life continuance. Therefore some degree of reproductive activity is necessary to the continued existence of any animal race, and it is probable that any degree of this activity is incompatible with continuous individual life.

The shedding of wandering cells appears to take place throughout the whole life of the higher animals. They may be found as amœboid corpuscles in the blood at all periods of growth. Only in the lowest forms, however, can they be developed as germs of new individuals at all periods. In all forms above the lowest some organ for their temporary reception must be first produced, in which the earlier stages of development can be passed, since the higher the animal the more unsuited is its germ for immediate self-nutrition. When the sexes become separate this grows more necessary, and individual development must pass through certain phases ere the organs necessary for reproduction are unfolded. Over this unfoldment of organs the nutritive conditions exert an important influence. Very active nutrition acts to check structural development. The writer has treated this subject at length in a former paper,[1] and need simply here refer to the case of insects in which structural development is retarded during the active nutrition of the larval stage, and is only actively resumed during the innutrition of the pupa stage. Thus with insects the conditions requisite to reproduction are only completed in the imago stage of development.

It is not alone reproduction that checks growth, since reproduction, under certain conditions, might long continue without that cessation of growth which usually accompanies sexual maturity. But reproduction, to be effective, must be of such a character as to assure the preservation and mature development of at least two offspring to every two parents. This can be done in one of two ways, either by the production of germs in great numbers, if they are left to take their chances of destruction by enemies or hostile natural conditions, or by the production of fewer germs, which are kept under parental protection until the young are able to shift for themselves. Both these processes are exhaustive of vitality. In the case of fish, which shed into the water immense numbers of sperm and germ cells, the physical strength is reduced by great abstraction of vital material. In the

[1] Growth and Development, AMERICAN NATURALIST, July, 1883.

case of land vertebrates, which produce much fewer eggs but furnish these with greater nutriment and give them special care there is similar exhaustion, as also in the case of mammals, in which a considerable development of the young takes place within the body of the parent. Thus as a rule growth ceases shortly after the period of sexual maturity is reached. The least exhaustive phase of this process is that displayed by the males of mammals, which lose but little vital material and waste little vital strength. They consequently exceed the female in size, yet not inordinately. The conformity in hereditary conditions, and in size of the initial life stage, act to prevent any undue excess in growth of males over females.

The conflict between reproduction and individual energy, however, is but one of the influences affecting the sizes of animals. There are conditions which affect the members of each separate tribe to which we must next advert. Whether two animals shall attain the same size does not depend entirely on whether they are able to obtain the same quantity of food. This is but one element in the problem. Another equally important element is the amount of exertion, physical or mental, necessary to obtain that food. The food is not applied within the body to the single purpose of growth. It is partly consumed in the production of animal heat, partly in recovering from muscular waste, partly in similar nerve recovery, and partly in reproductive activity, while only its excess goes to the formation of permanent new tissue.

As a rule it might be conjectured that cold-blooded animals would exceed the hot-blooded in size. They obtain their heat from without, and use up no nutriment in this purpose. But they are less active and efficient in the pursuit of food, and thus more than lose the advantage which their nutrient superiority might give them. Muscular activity is very exhaustive of nutriment, and we find that the more active animals are usually the smaller. Thus throughout their whole range the Herbivora exceed the Carnivora in size. And of each of these classes the most active species are the smaller. The great Carnivora, the lions and tigers, are only occasionally active. The bears are sluggish in movement. The smaller Carnivora, as the weasel family, are incessantly active. It is the same with the Herbivora. The elephant, rhinoceros and hippopotamus are usually slow moving creatures. The ox family is more active, and the much

chased deer and antelopes are kept in frequent swift motion. In fact the smallest Herbivora are those that trust to flight for safety, the medium sized those that need rapid motion in food getting but are safe from the attacks of Carnivora, or able to defend themselves, while the largest are those which need rapid motion neither for flight nor food getting. The desert-living camel, for instance, must be able to move very rapidly from oasis to oasis. And the horse needs swift motion over the partly barren plains which form its native home. But neither of these has occasion to fly from enemies.

Nervous activity is also repressive of growth, and the larger animals of each tribe are usually the duller mentally. But this is not the case where mental shrewdness replaces activity in the obtaining of food, or where the more intellectual animals possess highly efficient food-taking organs. The cuttle-fish is the largest and probably the most intelligent of mollusks, but its remarkably powerful weapons of assault enable it to obtain much food with little exertion. The same is the case with the elephant, whose trunk gives it special advantages in food getting. In these cases such mental energy as is exercised is correlated with physical sluggishness. In another case, that of the ants, the mental and physical energies are both in high activity, and this is perhaps a main reason why the ants, with plentiful food and no reproductive exhaustion, remain such small members of the insect race.

But a still more important agency in the growth of animals is the efficiency of their weapons of assault and their powers of motion in obtaining them a plentiful supply of food. In all cases the larger animals are those best adapted and situated for obtaining food with the least exercise of muscular and nervous functions. In this latter particular the sedentary animals are at an advantage, but it is far more than counterbalanced by the inefficiency of their means of capture. Unable to go in search of food, they are restricted to such food as they can bring to them by making currents in the water, or which they can capture in passing. To the former purpose the cilia of Protozoa, sponges, the lower mollusks, &c., the winnowing arms of barnacles, &c., are applied; to the latter the tentacles and thread cells of the Cœlenterata. Parasitic animals are also included in this category. None of these animals can grow to a great size, since the quantity of food they can obtain is necessarily very limited.

With respect to active animals their food-taking powers depend on one or more of three requisites, speed of motion, mental quickness and power of weapons. The largest animals among the Carnivora are those which have the highest development of this third requisite, and thus can obtain equal quantities of food with less organic exhaustion. It is not necessary to make a comparison of the weapons of various animals in this connection, as it is evident that there is a steady progression upwards as weapons grow more powerful, from the Protozoan cilia to the Mammalian claws and teeth.

But a highly important influence in this connection is that of special adaptation of animals to particular kinds of food, together with the comparative abundance of this food, and its comparative resistance to capture. The food of carnivorous animals does not tamely submit to destruction. It makes earnest efforts to escape or to defend itself. With animals that depend for safety on flight, and for food on pursuit, the great muscular exertion acts to check growth. Yet if these animals are capable of obtaining plentiful food they may become of considerable size. The weasels and their congeners are adapted to a kind of food which is small in bulk and is only to be obtained by great agility or cunning, often by pursuit through underground burrows. Hence their size is necessarily restricted, since overgrowth would unfit them for their life habits, and thus still further reduce their food supply. Their burrowing prey also are necessarily of small size, from the exigencies of their life habits and the small quantity of food which they are capable of obtaining. On the other hand the much chased deer are grass eaters, and are thus adapted to an abundant food which can be obtained without exertion. They therefore attain a considerable size despite the great muscular exertion which they need for safety. At the same time the larger Carnivora, which feed upon the timid Herbivora, obtain food in large masses, and grow in bulk accordingly, despite their great activity.

With the Herbivora the same rule holds. Their bulk is closely governed by the degree of agility necessary to obtain food, the resistance of this food to capture, its comparative abundance, and the exertion which they need to escape carnivorous foes. The nut-eating rodents, for instance, depend upon food which resists capture, and which can only be obtained in small quantities and

by considerable labor. Thus their food supply is greatly limited. The gnawing teeth of rodents are inefficient weapons as compared with the cutting teeth of Carnivora and the grinding teeth of the large Herbivora. The same remarks might be applied to the food and weapons of the Insectivora. Again, among rodents and in fact among all classes, the tree livers are smaller than the ground livers. They need great agility, their food is usually of reduced quantity, if vegetable food it is usually placed at the extremity of the small branches, if animal it escapes to this extremity, so that great bulk would either reduce the food-getting power, or the safety from danger. The largest arboreal animals are the climbing cats, which obtain their prey by springing, and these are much smaller than the ground-lurking cats. On the contrary the coiling and crushing serpents attain their greatest size in trees, which seem to offer them a special advantage in the capture of large prey.

In regard to those grass and leaf-eating Herbivora which have learned to defend themselves by weapons instead of by flight, and thus to avoid the excessive exertion of their timid relatives, their size is greatly influenced by the degree of exertion necessary to obtain a supply of food; that is, on the abundance of food native to their habitat. The camel, for instance, is native to sandy deserts dotted with occasional grassy oases, so that it needs swift motion and great powers of endurance of hunger and thirst, to enable it to shift from pasture to pasture. The horse also is native to broad, level plains, but sparsely provided with pasturage, and needs swift motion to obtain a sufficient food supply. A similar argument applies to the American bison and the larger deer. These animals, while attaining a considerable bulk, are much smaller than the slugglish tropical Herbivora, the elephant, rhinoceros and hippopotamus, which live among superabundant food, and have little occasion to fear enemies.

Again, as tree-living animals are necessarily small, so are mountain animals of reduced bulk. Though they are in no great danger from carnivorous foes, their food supply is small, and can only be obtained by great exertion. Reference may here also be made to the tribe of birds. These are necessarily smaller than land animals. The element in which they live requires great muscular activity, which increases in a rapid proportion with increase in bulk. Their food supply is also limited, and only to

be obtained by great exertion. But unlike land animals the largest birds are the Carnivora, since the food to which they are adapted is far more abundant than can be obtained by the pecking fruit-eating, or the insectivorous birds. But the largest of all birds are those that have lost the habit of flying, and with it the necessary muscular waste. And of these land birds the largest known to us were those sluggish inhabitants of the Pacific islands, whose habitat was untenanted by large Carnivora, and their food abundant, so that they did not need the activity of the desert-living ostrich.

If now we consider water animals, the considerations here taken receive a remarkable exemplification in the whale, with its bulk so greatly in excess of that of any land animal. An examination of the structure of the great Greenland whale would not lead to this conclusion. It has lost all the weapons on which its land kindred depend. Its teeth have vanished. Its hind limbs have disappeared. Its fore ones are only used for swimming. Its food-getting powers seem singularly reduced, while the food upon which it depends consists of minute, almost microscopic animals. Thus a natural conclusion would be that the whale should be of small bulk instead of gaining such monstrous proportions. But on the other hand its food is superabundant in quantity, and is utterly defenceless against its huge foe. The whale needs no weapons to capture its food. These would be useless and have been lost. All it needs is to rush rapidly through the water with open mouth and swallow the food which it thus collects in great masses. Intelligence would be useless to it, and is greatly lacking. Its muscular waste is comparatively small, since swift motion through the water needs far less exertion than on the land. It has no foes whom it endeavors to escape by flight. Thus there is nothing to hinder its attaining an inordinate bulk. In this whale, and related species of the same general habits, the powers of growth attain their ultimate development.

The same consideration applies to the great sperm whale, which is adapted, indeed, to a food of different character, but seems to obtain as abundant a supply with as little exertion. The remaining water mammals are smaller. They trust to food that is less abundant, and which needs more exertion to obtain. The seals cannot obtain their fish food without great agility, and it is

probable that the huge size of the great sea elephant arises from its being adapted to some less agile and more abundant food than that sought by its smaller kindred. With fish the same rule applies. The powerfully armed sharks far exceed any others in bulk, fish, as a rule, being inefficiently armed and adapted to small sized prey.

If we leave the vertebrates and consider the articulated animals, the same rules hold good. The insects are specially adapted to a restricted food supply, and their weapons are usually such as enable them to obtain food only in small quantities. The sucking, boring and rasping implements with which they work are of no great efficiency, and the largest insects are the strong-flying carnivora with their powerful pincers and jaws. The spiders are equally small, from the minute quantity of food which their cunning brings them. By far the largest articulates are the crustaceans, in whom the pincers have developed into powerful weapons, and who find in their water home larger, more abundant and more easily overcome prey. But in all these cases the size of any particular species is largely the result of the efficiency of its weapons, the size and quantity of the food to which it is specially adapted, and the degree of energy or cunning which it needs to capture its food and to escape its foes.

Thus it would appear that the size of every species of animal has a natural limit, about which it may fluctuate, but from which it cannot widely depart in either direction unless there occurs a marked change in the surrounding conditions or in its organization. Its size depends strictly on the efficiency of its food-taking weapons, the abundance of food to which it is specially adapted, or the mass of food material which it can obtain, the degree of exertion, muscular or nervous, which it needs to obtain this food, the degree of exertion which it needs to escape its foes, and the vigor of its reproductive energy. The latter, however, is a fluctuating element, which acts like the governor of a steam engine. The former conditions control the average size at any fixed period. But if, through a change of conditions, nutrition becomes more abundant, reproduction is correspondingly checked and size increases, while the reverse occurs if nutrition decreases. Thus by a correlation of its two powers of nutrition and reproduction each animal manages to hold its own in the struggle for existence. If, through any causes, an animal tribe falls below the

requisite level in both of these powers, it is in danger of extinction. If it rises above the level some other tribe is in danger of extinction. This latter is a highly important fact, to which further attention will be requisite after some other points have been considered.

We may here speak of the great influence which larval metamorphosis seems to have on the ultimate size of animals. With the invertebrates, as a general rule, the young come into the world half born. They are thrown upon their own resources in a partly developed state, and have a high wall of metamorphosis to climb ere they can reach the stage af maturity. During this larval period they represent animals of a lower grade of organization than the mature form, and more imperfectly adapted to food getting, except in those cases in which the mature form is a degenerated one, or in those other in which the mature form has lost its original adaptation to the food conditions, and thus is forced into immediate reproductive activity, as in the case of many insects. If we take, for instance, the actively feeding caterpillar and compare it with the butterfly, we find the latter, on leaving the pupa case, to be not more than a tenth of the size of its larva, while the new food stock, to which it has become adapted, is much less abundant and easily obtained than that open to the caterpillar. Thus growth force ceases, reproductive activity supervenes, and death of the mature animal quickly follows.

Vertebrates are tided over these larval stages, which they pass either in the egg or in the maternal womb. The loss of life vigor in their case falls upon the mother, not upon the offspring. The marsupials, in which the young are born imperfectly developed, are all comparatively small in size. This may not, however, arise from the cause specified, since the young obtain food from the mother without personal exertion until they have passed through the larval stage. As a rule, as pointed out by Herbert Spencer, the initial size of the animal exerts a vigorous influence upon its ultimate size. If it begins its individual life with large bulk and great food-taking and consuming powers, its growth will be proportionate. He instances the diversity in size of sheep and oxen feeding in the same pastures.

Intelligent selection, as exercised by man upon domestic animals, is capable of producing great variations in size. In the

domestic dog, for instance, a remarkable diversity has been in this way produced. The same effect, though less marked, appears in the other domestic animals. It has become strikingly produced in the horse without design, but merely through diversity in quantity of food, and in the necessary exertion to obtain it in different localities. In these instances we recognize the influence of heredity in preserving variations of chance occurrence. It may be remarked here that man is not the only animal which practices intelligent selection. Bees and ants pursue the same process with their own young, and with remarkable results. Thus with the hive bee a special feeding of one of the worker larvæ yields not only increased size but an important organic development. From being a sterile worker it becomes a functional female, or queen. In the ants the sterile forms often differ widely in size. Dr. McCook measured in one nest nine distinct sizes, the largest being seven times the length of the smallest. Whether this is a result of designed difference of nutrition of the larvæ does not appear, though there are two or three distinct duties in the nest to which ants of distinct sizes apply themselves.

But we have now to consider another phase of the subject which has been of extreme importance in its history. In addition to the influences whose effect upon the sizes of animals we have considered, there is another of equal, if not greater, efficacy. We look upon the tentacle as a weapon of minor power, yet in the cuttle-fish it has become an exceedingly powerful instrument, and through its aid giant animals have been produced. The same may be said of the weapons of the Crustacea, which sufficed, in an early geological period, to yield crustaceans of six feet in length. Even the Medusæ, with their apparently feeble food-taking powers, occasionally attain to great bulk. They are perhaps situated like the whale in the midst of an abundant supply of defenceless food, which can be obtained without special exertion. The defenceless prey of these great sluggish animals are those small creatures which trust to excessive reproductive powers for continuance of their race, and thus have less need of efficient personal defence than with the less prolific.

These cases point to the condition now to be reviewed, that of comparative ability to share in the limited food supply. The struggle for existence is by no means confined to the power of attack and defence, but also takes the form of a struggle to obtain

a full share of the naturally supplied food. This has been one of the most potent agencies in the history of animal development. The living tribes of nature sit down to a bountifully supplied table from which each eagerly seeks to gain a "lion's share" of food. Of those that are adapted to a certain kind of food, on a certain part of the table, the best armed and situated will obtain the most, and increase in size over their less fortunate competitors. On another part of the table animals equally well armed are served with a more meager repast, and thus need greater activity to obtain equal or smaller quantities of food. They consequently decline in size below their better situated relatives. The degree of competition, however, is reduced by the fact that many tribes are adapted to food of quite different kinds from that sought by others. Yet every class of food is eagerly sought for, so that there is everywhere a sharp competition, and the animal so organized and situated as to obtain the most with the least exertion of body or mind, is sure to outgrow all rivals of equal advantages and initial powers of organization. It may be here remarked also that at this great feast of nature the food often resists capture, and is not to be taken without special exertion. Some offers no resistance, some is enclosed in hard or spiny armor, some has active powers of motion and needs to be pursued. Thus the competition is great in degree and in variety, and the sizes attained by the different guests depend greatly on the quantity of food they succeed in obtaining in fixed periods, and the waste of tissue necessary in the struggle.

This competition, while highly influential in keeping existing animals each to its limit of size, was probably, in the geological periods, the most efficient agent in controlling the sizes of animals, far more so than the direct struggle between Carnivora and their prey. A rapid review will show this. In tracing the succession of animals in former ages one fact of importance appears. This is, that the members of the animal kingdom only by slow degrees advanced in the utility of their weapons of attack and defence, in their agility and in their mental ability. In consequence of this successive development the geological periods present us with some highly interesting conditions of animal life, which are of interest in the present connection. Successive waves of life have passed over the earth, each swelling to a cul-

minating point of height and then declining, to be followed by a new wave, and each of superior structure than the preceding. Each wave of life, in fact, has been forced down by the succeeding and superior one, until now the human wave has risen and is forcibly breaking down that which last preceded it.

(To be continued.)

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DR. D. E. SALMON'S CLAIMS RESPECTING THE DISCOVERY OF THE GERM OF SWINE-PLAGUE.

BY H. J. DETMERS.

IN No. 53 of vol. III, of *Science*, pages 155 and fol., appeared an article by Dr. D. E. Salmon, in which he claims priority in the discovery of the cause of swine-plague with reference to my own researches. Since my claims, recently admitted by Pasteur, and in 1880 by the professors of the Royal Veterinary School at Berlin (see page 464 and 465 of the Archiv für wissenschaftliche und práctische Thierheilkunde, vol. VI, part 6), are thus directly disputed, it is incumbent upon me to vindicate them. That Dr. Klein discovered in 1876 microorganisms in the carcasses of hogs that had died of swine-plague, I have nowhere disputed; neither have I expressed any doubt that Dr. Klein may have seen the very micrococci which constitute the cause of the disease. In fact, I have never seen Dr. Klein's report. Only brief extracts of the same have ever come to my knowledge, from which, however, I have not been able to learn that Dr. Klein demonstrated the causal connection of these bacteria with the disease. This proof, absolutely necessary in order to show the parasitic nature of the disease, I was the first to furnish. In special report No. 12, and in the annual report for 1878, of the commissioner of agriculture, can be found a detailed account of my researches. In these I discovered a specific microorganism in the fluids, morbidly affected tissues, and morbid products of the diseased animals, as well when killed by bleeding, as also in the perfectly fresh carcasses of those that had died of the disease. These bacteria were cultivated outside of the animal body, in innocent media, such as milk, mutton broth, and other fluids (see page 37 of the commissioner's special report No. 12, or page 347 of his annual report for 1878).

An inoculation with the bacteria, thus cultivated, reproduced

the disease in due time in healthy pigs (see history of experimental pig C on pages 37, 38 and 39, or pages 347 and 348 of said reports). The quantity of bacteria employed in infecting the sterilized culture-fluids was so small, compared with the bulk of the latter, as to render them harmless by dilution, had the bacteria not multiplied in the flasks. After three days' (from Sept. 23d to Sept. 26th, 1878) cultivation the fluids swarmed with the identical bacteria with which they had been infected, while no others could be found by close and searching microscopical examination. Staining fluids, it is true, were at that time, September, 1878, not employed, but even should these cultures have been contaminated to a minimal extent, the validity of the proof that they reproduced the disease would thereby not be affected. Moreover, I have given abundant proof in my reports that a vegetation of putrefaction bacteria, the very ones most likely to intrude into a culture fluid, destroys, if taking place in the same medium, the pathogenic properties of the swine-plague bacteria, a fact admitted by Dr. Salmon himself in his later reports. As the disease produced by inoculation with an exceedingly small quantity of the cultivated material was typical swine-plague, a more decisive proof of the bacteritic nature of that disease cannot be furnished. Still, although further proof is not really needed, I may yet mention that an inoculation with blood serum from diseased lungs, after it had been freed from the swine-plague bacteria, remained ineffective, notwithstanding that every inoculation with the same material, if not freed from swine-plague bacteria, invariably took effect (see history of experimental pig A, inoculated Oct. 14th, 1878, pages 38 and 39 of special report No. 12, and pages 348 and 349 of the annual report for 18-). But, while I will not relinquish my claim of being the first who has proven the bacteritic nature of swine-plague, I can readily admit any mistake in the description of the bacterium. The insufficient instrument then at my command, a small Hartnack stand, and three Hartnack objectives, a No. 2, a No. 5, and a No. 8, made the coccus-chains appear like moniliform (serrated) rods. Hence my error in naming them bacilli. Although I have since corrected this mistake in the nomenclature in my report of February 28th, 1880 (see page 60 of special report No. 22, page 412 and fol. of the commissioner's annual report for 18-), frequent repetition of my observations has not forced me to con-

sider anything wrong in my first description beyond the drawings of the bacteria. Better lenses, afterwards employed, easily resolved the apparently moniliform rods into coccus-chains. The same reports of the commissioner, which contain the results of my first researches, also contain Dr. Salmon's first observations on swine-plague, in which he does not make a single reference to bacteria as the cause of the disease.

In the following reports, special report No. 22, and annual report for 1879, I corrected my mistake as to the appearance and the naming of the parasites; while the subsequent report of the commissioner, special report No. 34, or annual report for 1880, which was published a year later, or two years after I had proved swine-plague to be a bacteritic disease, contains the first account of Dr. Salmon's observations in regard to swine-plague bacteria. However ingenious his methods were, however exactly he copied Pasteur's method of experimentation, his results are nowise in advance of mine, published respectively one and two years earlier. I can safely let the reader estimate the value of his and my claims of priority. In my various drawings I have tried to represent what I actually saw in the fluids, morbid tissues, etc., of the animals, and hence have shown different forms of the bacteria, among them Billroth's helobacteria. I have not seen these forms in my cultures, neither have I ever said that the same were proven to be related to the disease, however likely that may be. On pages 61 and 62 of special report No. 22, or the corresponding pages of annual report for 1879, after quoting from Billroth, I remark: "As nearly all these various changes and formations have been repeatedly observed, it *may be* that these club-shaped formations or helobacteria of Billroth, which I was inclined to look upon as foreign to the disease, are only a higher development, or another form of the swine-plague Schizomycetes."

Dr. Salmon's insinuations have no foundation whatever, and his accusations that I have confounded the true parasites (diplococci) of swine-plague with other bacteria cannot be substantiated from my writings.

CHICAGO, ILL., March 20th, 1884.

THE SEGMENTAL SENSE-ORGANS OF THE LEECH

BY DR. C. O. WHITMAN.

THE only sense-organs hitherto known in the medicinal leech are the five pairs of eyes and the so-called "goblet-shaped" organs located in the edge of the lip (cephalic lobe). A number of writers have noticed and described some small spots occurring on every fifth ring of the body; and one author has suggested that they may have a respiratory function. But no one, so far as the published accounts inform us, has intimated that they represented sense-organs, or suspected that they were the serial homologues of the eyes themselves. These spots, when examined closely with a low magnifying power, will be found to be slight elevations with rounded summits, and for this reason and because they are regularly disposed on the first ring of each segment (somite) they may be called segmental papillæ, a name which does not prejudge the question of their function. In our large pond leech (Macrobdella) these papillæ are comparatively small; and the same may be said of the medicinal leeches of Europe and Japan, and their nearest allies, Hæmopis and Aulostoma. In some of the Asiatic medicinal leeches, for example, those of Saigon, Singapore (*H. maculosa*), Java (*H. javanica*) and Ceylon (*H. multistriata*), they are much larger and have an oval form with a median ridge or crest. In the land leeches they are very conspicuous, having the form of small cones with rounded summits.

In all the ten-eyed leeches of Japan, including both the land and fresh-water forms, twelve of these papillæ are found on the first ring of each complete somite, six on the dorsal and six on the ventral side. In most of the medicinal leeches, however, as well as in Hæmopis, Aulostoma, Macrobdella, &c, there are eight on the dorsal side and six on the ventral.

A careful study of the *arrangement* of these papillæ in a large number of species, and of their histological structure, has brought out in a most conclusive manner their *serial homology with the eyes;* and has led, indirectly, to the recognition of some important points in regard to the metameric composition of the body of the leech. The accompanying diagram will enable me to be brief. The eyes are represented by five pairs of large black dots, the segmental papillæ by smaller dots. The numerals on the

left give the number of somites, those on the right the number of the first ring of each somite. The position of the seventeen pairs of nephridial pores is shown by short dashes (*1st p–17th p*). With the exception of the genital and nephridial pores, the diagram shows only what belongs to the dorsal side. It will be seen that there are twenty-six *transverse* rows of papillæ—one for each somite; and that, owing to their uniform and symmetrical arrangement, they form also eight *longitudinal* rows. We have *two median* rows (*m*) formed of twenty-five successive pairs; *four lateral* rows, an *inner* (*il*) and an *outer* (*ol*) on each side of the median line; and *two marginal* rows (*mg*). The first two eyes hold the position of a pair of median papillæ, while the remaining eyes replace as many *inner lateral* papillæ. About this correspondence in position there is not, in my opinion, any room for doubt. In the diagram the outer lateral and the marginal papillæ are to be seen as far forward as the first eye-bearing ring, the marginal ones alone being absent on this ring; but in most species of Hirudo both of these rows of papillæ are very indistinct or entirely absent on the first three eye-bearing rings. They are present in Aulostoma, and are very distinct in the large medicinal leeches of Saigon, Singapore, Java and Ceylon.

The median rows of papillæ, if their position is not misleading, must be regarded as the metameric equivalents of the *first* pair of eyes; the inner lateral rows hold the same relation to the second, third, fourth and fifth pairs of eyes. There is a possibility that the first pair of eyes are derivatives of the inner lateral papillæ, the median papillæ of this ring having been lost and the eyes brought nearer together so as to stand in line with the median papillæ of the following somites. However, as all the papillæ have the same structure, there is no objection on this score to the opinion that the eyes are derived from both the median and the inner lateral papillæ.

The structure of the papillæ confirms the homology above indicated, if one feature alone be excepted. The eye of the leech, as is well known, is a cylindrical mass of cells, three or four times as long as wide. The central or axial portion is made up of peculiar large glassy cells, in general appearance entirely unlike the other cells of the body. What the peculiarities of these cells are cannot well be explained without illustrative drawings; but for present purposes it will be sufficient to say that each of

these cells has a vacuole-like space occupying a central position which is probably filled with some kind of fluid. Whatever this fluid may be, it is not colored by any of the dyes in common use. The protoplasm of these cells forms a thick peripheral envelope with a rounded thickening on one side which projects into the vacuolar space. The very small nucleus is usually located near the base of this internal protuberance. This axial portion consisting of clear cells is enveloped by a thick layer of pigment on all sides except the external end. The epidermal cap covering these cells is convex, and entirely free from pigment, forming thus a window-like opening into the black pigment-cup which holds the large transparent cells. An optic nerve enters the eye near its deeper end, and runs along the axis for a larger portion of its length. It is probable that branches of the nerve connect with the clear cells, but precisely how has not been ascertained.

In sections of the segmental papillæ we find all the elements of the eye except the pigment. There is a branch of the lateral nerves that runs to each; and from four to six or more of those peculiar large glassy cells are found a little below the epidermal cap, which is convex and free from pigment.

The absence of a pigment-cup holding the glassy cells makes it doubtful whether the papillæ can be regarded as light-perceiving organs, but it does not, to my mind, weaken the evidence of their serial homology with the eyes. It is generally found that the posterior eyes, especially the fifth pair, are smaller than those preceding them; and I have noticed cases in which only a mere trace of pigment could be seen in one or both of the last pair of eyes. While it appears doubtful what the function of the papillæ is; still, the presence of large cells precisely like those in the eye, situated just below a window-like opening in the surface pigment, and their obvious serial equivalence with the eyes, makes it not improbable that they represent incipient organs of vision.

Although the evidence appears to me conclusive that the eyes and the segmental papillæ were, originally, morphological as well as physiological equivalents, it does not of course follow necessarily that both now have the same functional significance. The original papillæ may have represented sense organs of a more or less indifferent order, among which, in the course of the historical development of the leech, a division of labor was introduced, a few at the anterior extremity becoming specialized as organs of

vision, the rest either remaining in their early indifferent condition, or becoming specialized in some other direction.

In order to get a clearer and fuller idea of the fact that the eyes are metameric organs representing merely structurally improved forms of the segmental papillæ, let us look more closely at the rings and the somites composing the body. As a glance at the diagram will show, there are in all 102 rings between the first pair of eyes and the posterior sucker; the last two or three are more or less imperfect. The papillate rings show us precisely how many somites there are. Of the *twenty-six* somites, *sixteen* (7-22 inclusive) have each five rings, while the remaining ten have from one to three rings. Of these abbreviated somites *six* form the anterior and *four* the posterior end. We notice that the abbreviation is greatest at the extreme ends, from which it is plain that it began at these points and progressed towards the center of the body. The first two somites have each a single ring, the third is represented by two rings, and the fourth, fifth and sixth each by three rings. The first six somites then include only thirteen rings, less than half the number contained in six complete somites, such as are seen in the middle region of the body. The twenty-third somite embraces three rings, and the twenty-fourth, twenty-fifth and twenty-sixth each two rings. The last four somites contain only nine rings. The abbreviation not only extends to a larger number of somites at the anterior end than at the posterior, but it has been carried farther in the individual somites, at least in the first and second. At both ends the papillate rings have been preserved, while the less important non-papillate rings have been in part or wholly suppressed. The suppression of rings takes place by consolidation, two successive rings gradually coalescing. The papillate ring may coalesce either with the preceding or the following ring. In the medicinal leech the fifth ring, bearing the fourth pair of eyes, is now in process of uniting with the sixth; while the eighth is absorbing the seventh. The evidence that these two rings are being swallowed up is seen first of all in the rings themselves, and secondly, in the different conditions which they exhibit in different species and genera. In Hirudo and several allied genera the sixth and seventh rings are comparatively narrow, and the grooves separating them from the fifth and eighth rings are entirely obliterated on the ventral side, so that here the four rings appear as two. On

the dorsal side they are still distinct, but not so deeply marked off from the fifth and eighth rings as from each other. The same process of consolidation is seen in Hæmopis, Aulostoma and Hæmadipsa, but in different stages. In Macrobdella all four rings are distinct on both sides, but the consolidation has already begun, as the grooves separating the fifth from the sixth, and the seventh from the eighth, are not so deep as the groove between the sixth and seventh, or that between any two of the succeeding rings.

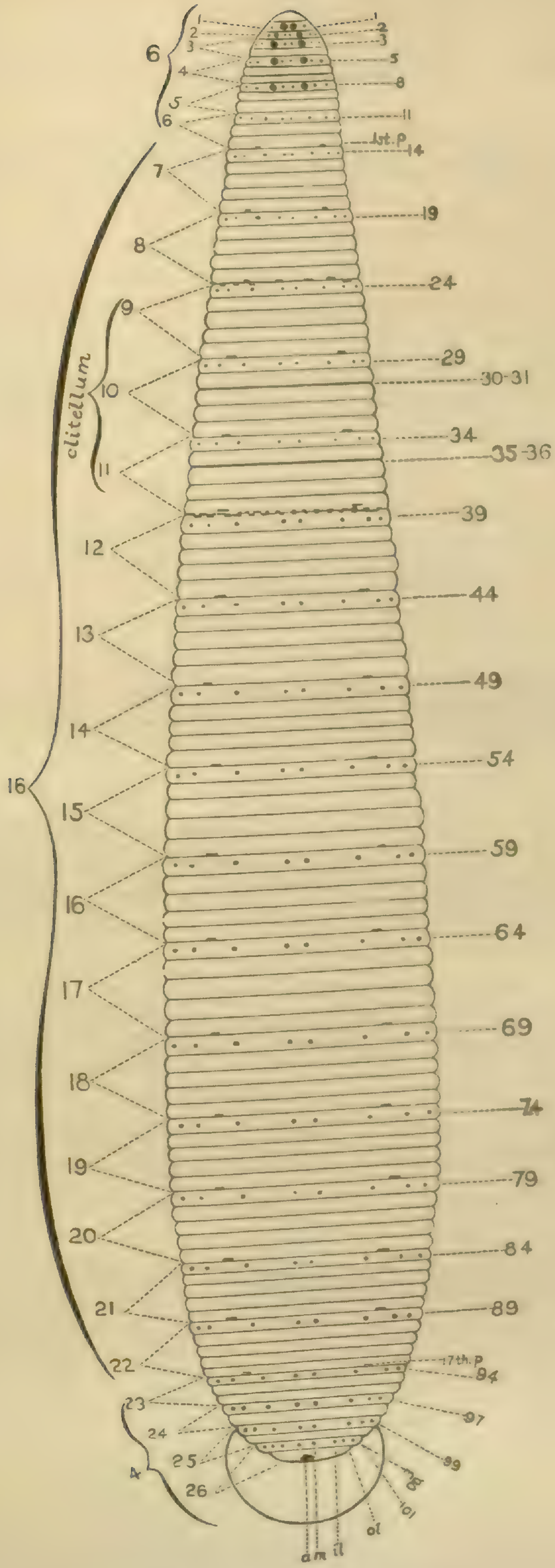
If the abbreviation is centripetal, we should expect the fourth ring to disappear before the sixth and seventh. This course of events has already been completed in the land leeches, in none of which is there a ring intervening between the third and fourth pairs of eyes.

Two non-papillate rings may also unite with each other; an instance is seen in the twenty-third somite of Macrobdella, where the second and third rings are well nigh consolidated.

The syncopation of rings has been carried farther in the acetabulum than in either of the posterior somites. In some species the segmental papillæ are quite distinct on the disk, and in these their arrangement shows that papillate rings alone have been preserved in this region.

The sacrifice of rings has been greatest in those parts that have been compelled to do the most work, namely, the two extremities. In the anterior somite the papillate rings have been preserved and functionally improved in proportion to the number of the less important non-papillate rings eliminated. In the posterior disk the loss of rings is not correlated with an improvement of the sense-organs, but with an increased development of muscles. The habits of the land leech have favored the development of a still greater muscular power in the disk, and this has been attended with a loss of five rings, leaving only four rings in its four terminal somites to offset nine rings on the aquatic leech.

If the historical development of the leech has been a progressive course of abbreviation such as we have described, it is evident that an ancestral form must have existed in which the somites were more nearly alike from end to end. The embryonic development confirms this view, for in its earlier phases the somites form a chain of very nearly equal parts. It is somewhat later that a few (7–8) of the posterior somites become constricted off and



Segmental Sense-Organs of the Leech.

consolidated into the sucking disk. The somites at the anterior end are the first to arise and hence the first to exhibit specialization.

Among existing species three in Japan have departed less from the hypothetical ancestral form than has Hirudo. They agree with the medicinal leech in having twenty-six somites, but differ from it in having eighteen instead of sixteen complete somites. In one of these species there are plain evidences that abbreviation has already begun in one of the eighteen somites.

The segmental papillæ then enable us to give a tolerably complete analysis of the body, to read some chapters in its past history, to predict some portions of its future, and to draw a few safe conclusions respecting the phylogenetic relationship of different species and genera. The discovery that these papillæ are sense-organs might lead us to speculate on affinities of a more distant and uncertain nature; such as are supposed by the writer, in common with many others, to exist between annelid worms and vertebrates. At all events the existence of such organs in the leech furnishes a broader basis for the discussion of the question whether the vertebrates and annelids have been derived from a common form possessing metameric sense-organs.[1]

Assuming that the sense-organs of the lateral line of the vertebrate and the segmental papillæ of the leech may be traced to a common origin in some remote ancestral form, it does not follow that they should now present close structural resemblances. It is far more important to show that they possess certain general features in common. The most important of their common features is undoubtedly their metameric origin. The nerve-supply forms another feature of fundamental importance, in which according to the interesting observations of Mr. Beard on "the segmental sense organs of the lateral line" (*Zool. Anz.*, VII, Nos. 161, 162) of the vertebrate, there is essential agreement. The develpmental history of these lateral organs in the fish, where they make their first appearance as *segmental papillæ* in the strictest sense of these words, cannot at present be explained on a more satisfactory hypothesis.

[1] Dr. Eisig of the Naples Station is the original expounder of this view.

THE AMBLYPODA.

BY E. D. COPE.

THE Amblypoda is that order of hoofed mammals in which the internal bones of the carpus are in linear series, the magnum supporting a part of the lunar only, and not reaching the scaphoid; and in which the tarsal bones are interlocked, as in the later types of hoofed Mammalia; that is, the cuboid bone articulates extensively with the astragalus, as well as with the calcaneum (see Figs. 1–2).

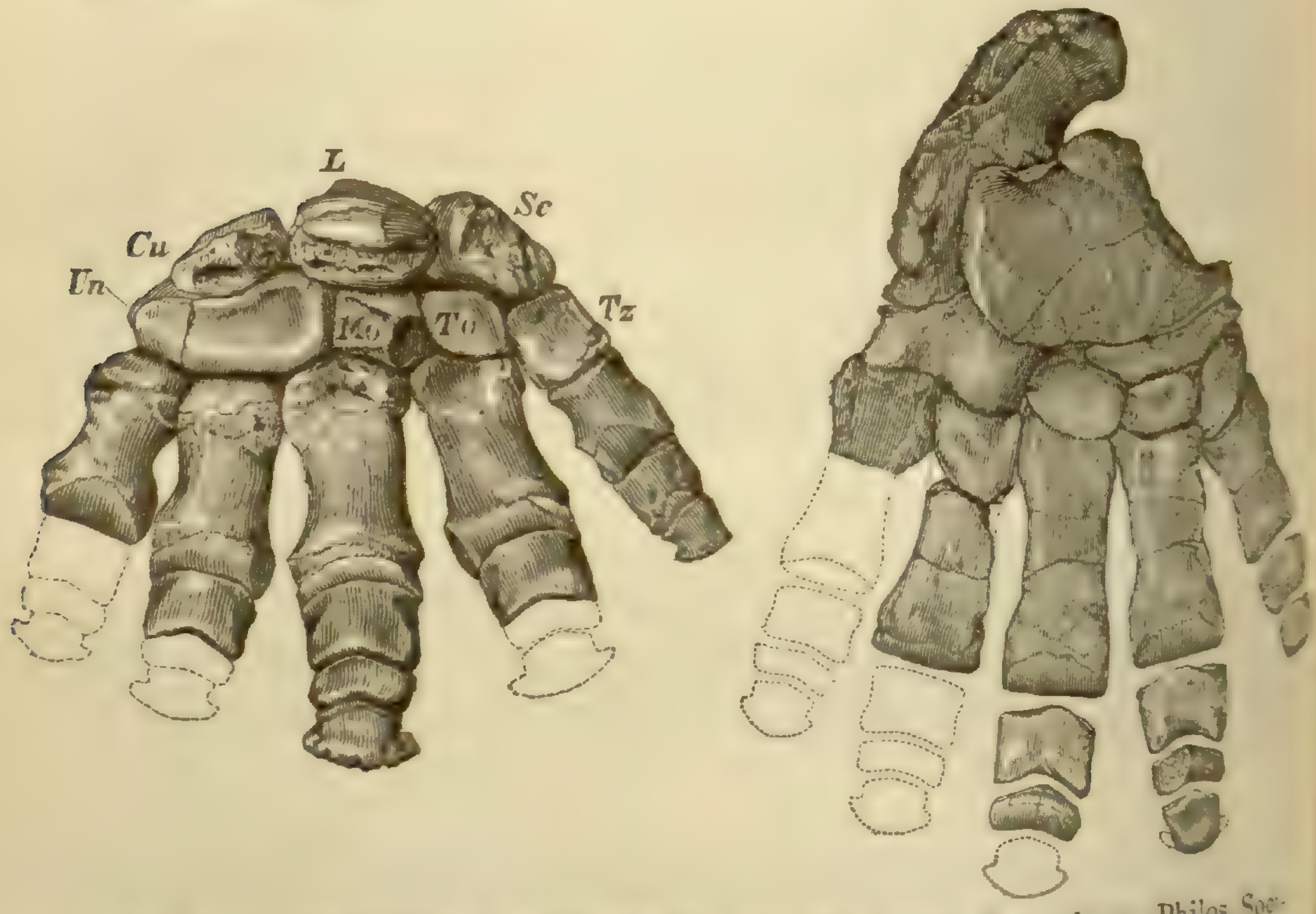


FIG. 1.—Right manus of Coryphodon. Original, from Proc. Amer. Philos. Society, 1882, p. 441. *Sc*, scaphoid; *L*, lunar; *Cu*, cuneiform (imperfect); *Tz*, trapezium; *To*, trapezoides; *Mo*, magnum (face broken); *Un*, unciform. From a New Mexican specimen. See Report U. S. G. G. Survey W. of 100th mer., IV, pl. LXI.

FIG. 2.—Right posterior foot of a species of Coryphodon from New Mexico, one-half nat. size. From Report Expl. W. of 100th mer., G. M. Wheeler, IV, pl. LIX.

Various other characters are associated with these, some of which may be coëxtensive with them, and therefore to be regarded as characters of the order. Thus all the known species have five toes on all the feet, and a flat astragalus without trace of groove. The unciform bone is extensively in contact with the lunar, as in the Diplarthra. The hemispheres of the brain are of singularly small size, and are separated from the olfactory lobes and from the cerebellum by their crura. The feet are always short and plantigrade.

Ordinal characters of wider significance are seen in the pres-

ence of a postglenoid process; the presence of enamel on the teeth, and the absence of any teeth growing from persistent pulps. The superior molar teeth are constructed on the tritubercular type.

Mammalia presenting the above combination of characters first appear in the Puerco Eocene epoch, and continue through the Wasatch and Bridger epochs, and then disappear. They have not been found in later deposits. The Puerco species are smallest in dimensions, while those of the Bridger epoch are the largest of Eocene Mammalia, equaling in the size of some of their bones the largest of living terrestrial Mammalia. Besides their great size the species of the Bridger epoch prove the ancient exuberance of their growth-energy in the development of extraordinary processes and horns on the head and large and formidable canine teeth.

Three suborders represent this order. Each one is confined to a distinct horizon of the Eocene period, with one doubtful exception. The characters are as follows:

Astragalus with a head; a third trochanter of femur; superior incisors.. *Taligrada.*
No head of astragalus; a third trochanter; superior incisors..... *Pantodonta.*
No head of astragalus, nor third trochanter, nor superior incisors..... *Dinocerata.*

The Taligrada only occur in the Puerco epoch, the Pantodonta are confined to the Wasatch, and the Dinocerata belong to the Bridger epoch, one species having been found extending downwards into the Wasatch, unless there be some error.[1]

The Taligrada.

The Taligrada are represented by one family, and one genus, Pantolambda Cope.[2] This form is interesting on various accounts. It furnishes the only known example of a tritubercular selenodont superior molar dentition. That is, each of the three cusps of which the crown of the superior molar is composed, is a well-formed V (Fig. 3 *a*). We shall see later on, that this form explains the origin of the peculiar molars of some of the Pantodonta. Its astragalus is of remarkable form, which is intermediate between that presented by the other members of the order, and the diplarthrous ungulates, as for instance, the rhinoceroses (Fig. 3, fig. *d d' d''*). It has the flat tibial face characteristic of all the Puerco mammals, and of many of those of the Wasatch

[1] This is the *Bathyopsis fissidens* Cope.
[2] See Naturalist, 1883, p. 406.

epoch. The inferior molars are much like those of Coryphodon, but differ in certain details. The premolars are even more like those of that genus (Fig. 6). The humerus differs from that of all other members of the order in having an epicondylar foramen (Fig. 5 *a*). In this respect, and in its large internal epicondyle, the form is like that of some Creodonta. The ilium differs remarkably from that of the other genera of the order in its narrow form, with flattened

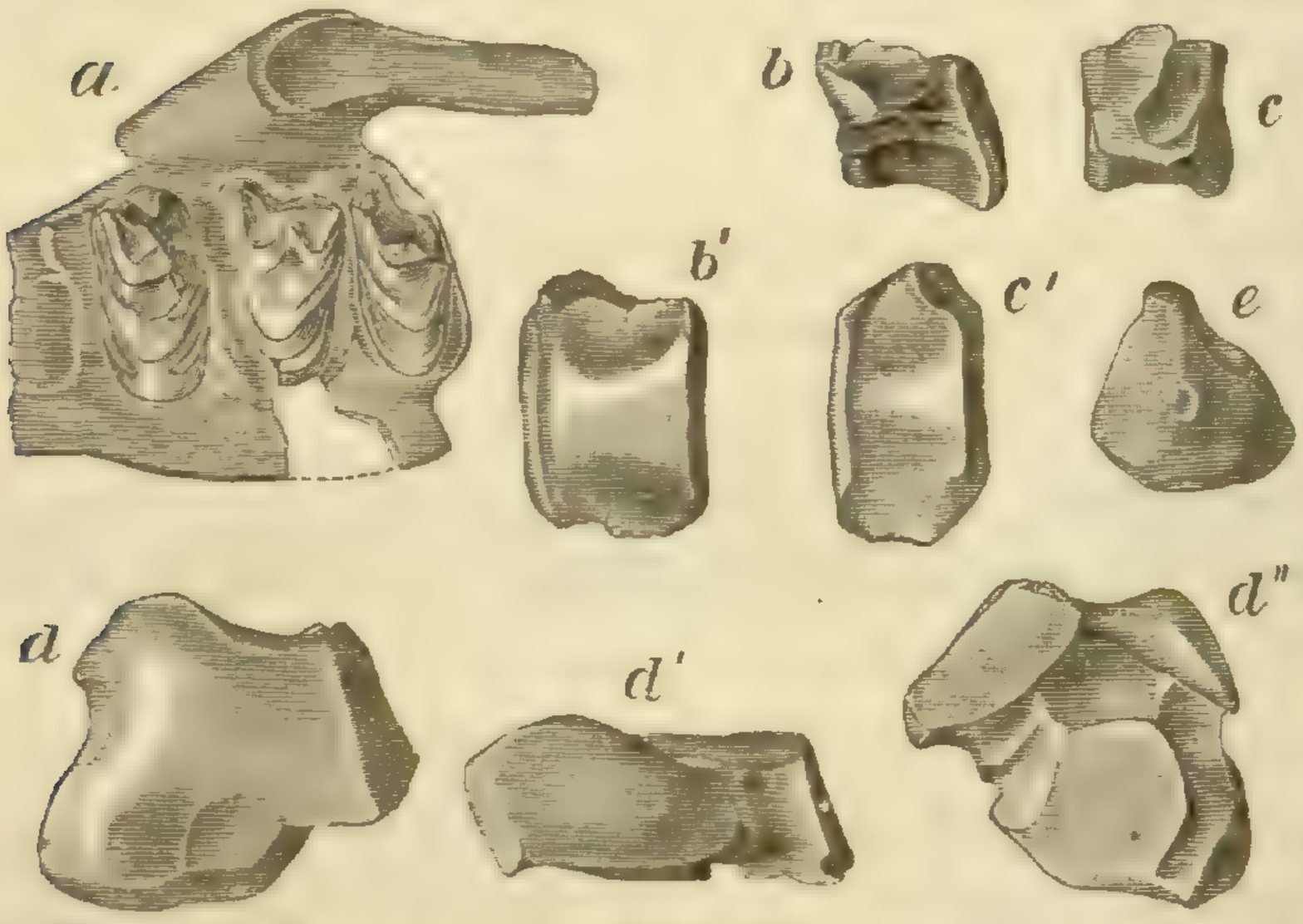


FIG. 3.—Bones and teeth of *Pantolambda bathmodon* Cope, two-thirds nat. size. From the Puerco beds of New Mexico. Fig. *a*, part of maxillary and malar bones from below, showing true molars, all somewhat broken. Figs. *b* and *c*, cervical vertebræ, left side; *b'* and *c'*, do. from below. Fig. *d*, astragalus from above; *d'*, from front, showing facet for cuboid; *d''*, from below; *e*, navicular bone from below. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden.

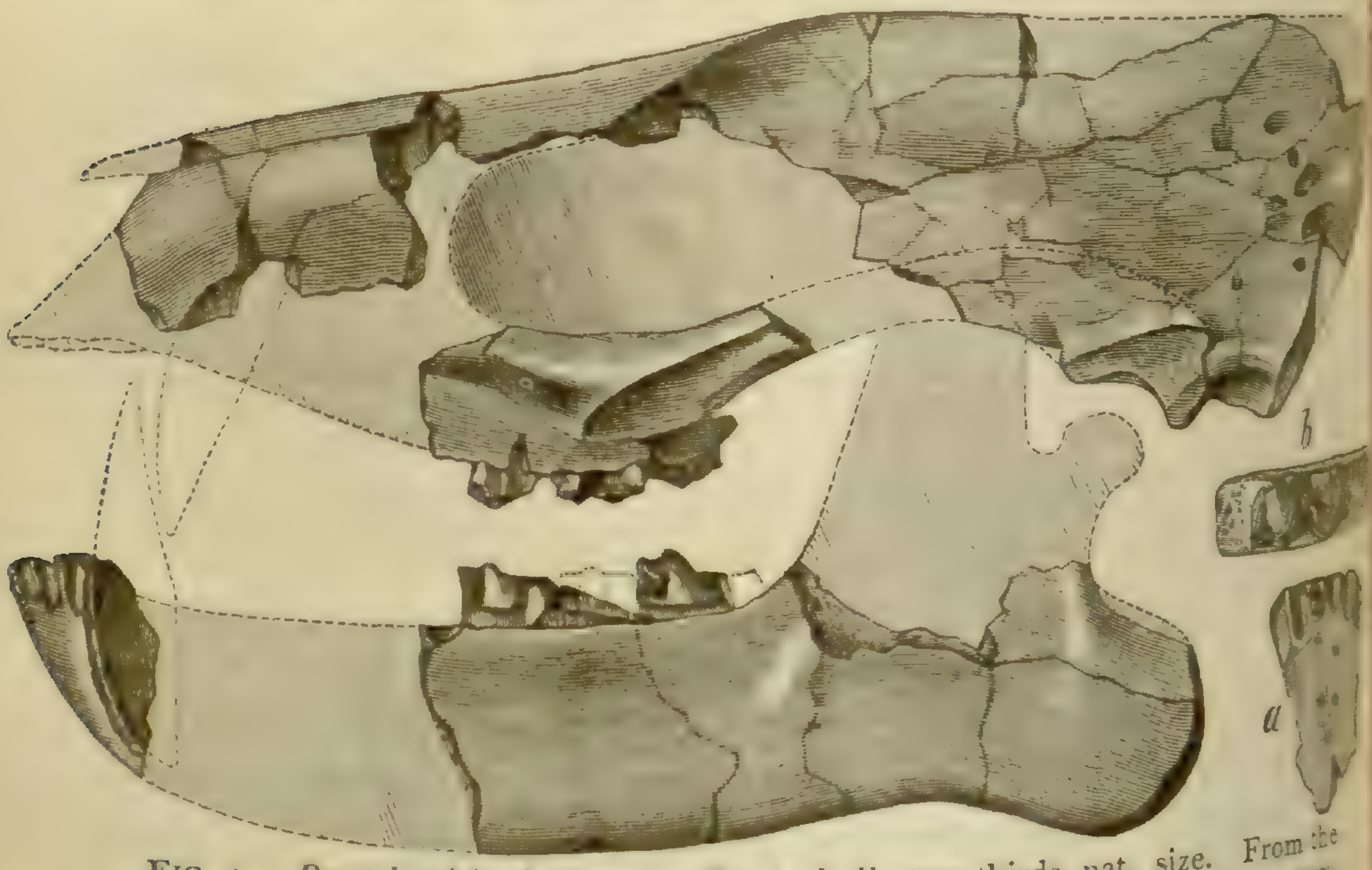


FIG. 4.—*Pantolambda bathmodon* Cope, skull, two-thirds nat. size. From the Puerco beds of New Mexico; individual represented in figs. 3 and 5. Fig. *a*, symphysis mandibuli from front. Fig. *b*, last two premolars and first true molar of inferior series from above, of a second individual. Original, from Vol. III Report U. S. Geol. Survey of Terrs., F. V. Hayden in charge.

triangular section, as is seen in various Rodentia. It approximates the Condylarthra in this respect also.

In all respects Pantolambda presents primitive characters. The V shape of its molar tubercles only presents us with the highest known modification of the primitive tritubercular molar,[1] excepting those which succeeded it in time in the remaining suborders of the Amblypoda.

Of the genus Pantolambda two species have been discovered, both by Mr. David Baldwin, in New Mexico. The smaller of these, the *P. bathmodon* Cope (Fig. 4) is about the size of a coyote, the larger, *P. cavirictus* Cope (Fig. 6) is as large as a South American tapir, or nearly equal to the smallest species of Coryphodon. The ungues of the *P. bathmodon* which have been found (Fig. 5 *c*) are narrower than those of the *P. cavirictus*, but they may differ in proportions on different digits as in the species of Phenacodus. Both species are furnished with formidable canine teeth, but they are of normal form, and do not present any of the peculiarities of those of the Pantodonta or Dinocerata. In the lower jaw of the *P. cavirictus* (Fig. 6) they are somewhat recurved, furnishing a formidable seizing and holding weapon. The lower edge of the mandibular

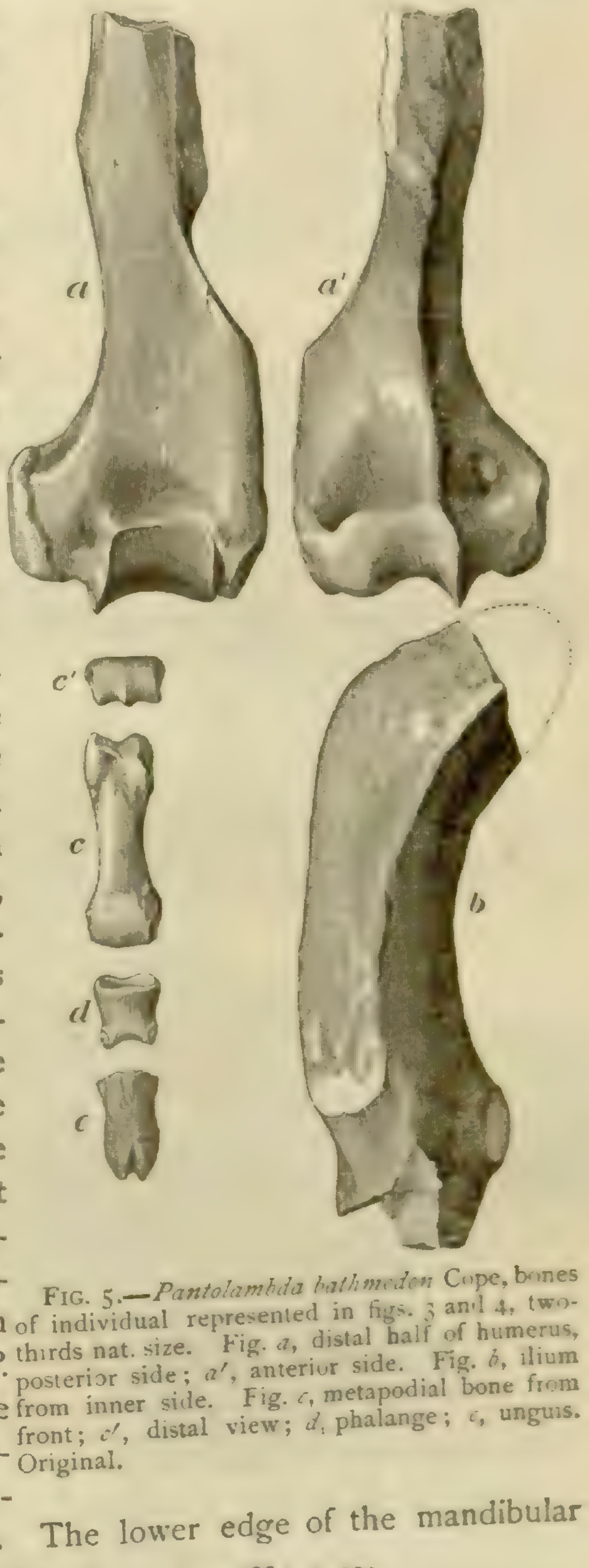
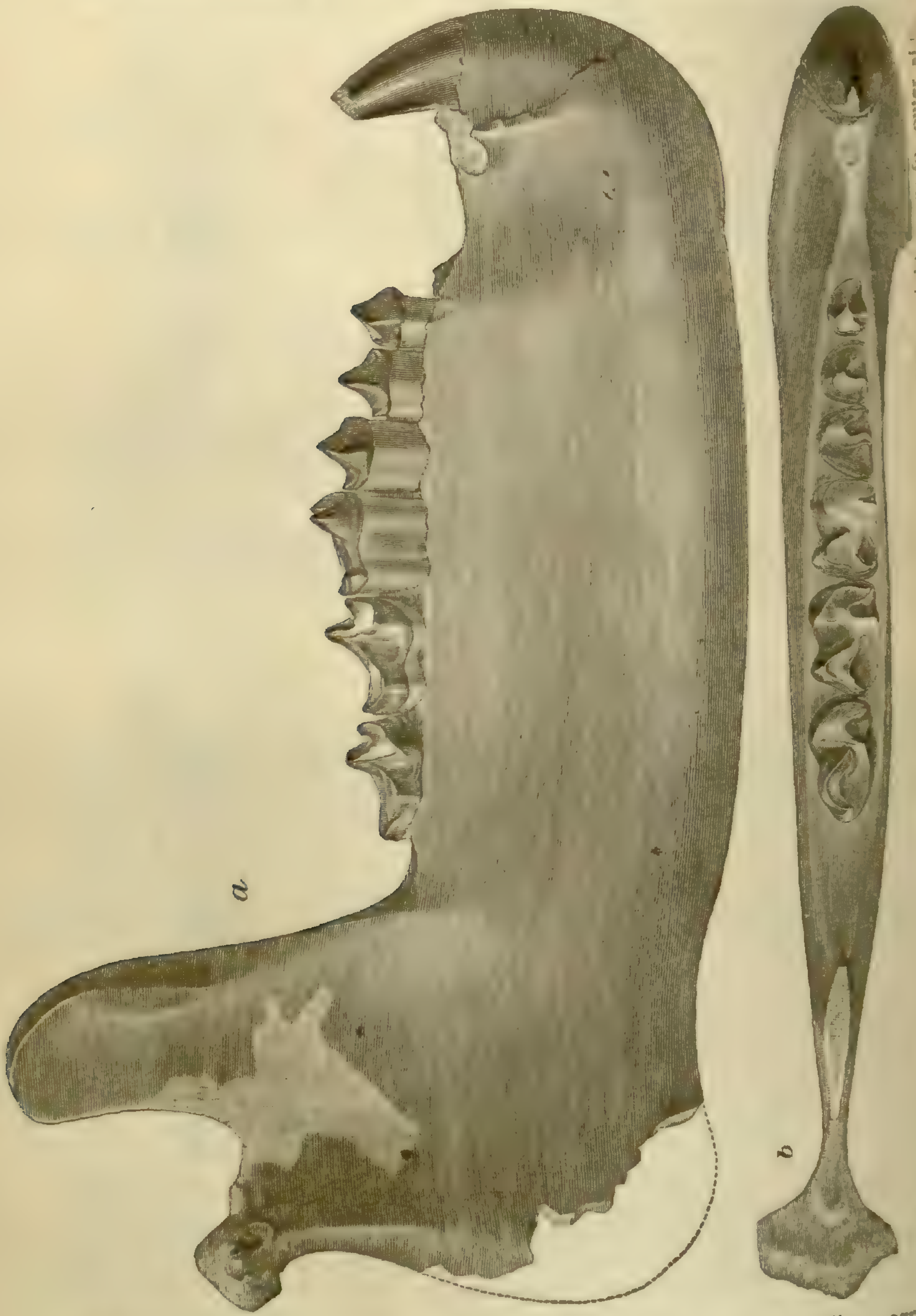


FIG. 5.—*Pantolambda bathmodon* Cope, bones of individual represented in figs. 3 and 4, two-thirds nat. size. Fig. *a*, distal half of humerus, posterior side; *a'*, anterior side. Fig. *b*, ilium from inner side. Fig. *c*, metapodial bone from front; *c'*, distal view; *d*, phalange; *e*, unguis. Original.

[1] On this subject see Proceeds. Amer. Philos. Soc., 1883, p. 324.

ramus is prominent anteriorly, leaving a concavity of the latera face posterior to the root of the canine. This resembles a good deal what is seen in the cat-like genus Nimravus and allies, which



are probably the ancestors of the saber-tooth tigers. The corresponding form in Pantolambda in the same way foreshadows the great development of mandibular flange, and of the superior canine, seen in the Dinoceratous group of this order.

The homologies of the parts of the teeth of the different genera of the Amblypoda are not determined without considerable study. The greatest difficulties are presented by the superior molars, and in order to understand them it is necessary to study the inferior molars first.

If we compare the inferior molars of the *Pantolambda cavirictus* with those of the *Bathyopsis fissidens* (Fig. 7) (one of the Dinocerata) the following modifications will be observed: (1) The two limbs of the anterior V in the true molar of the former are represented in the latter by a single crest with two appressed apices at the inner extremity. These apices represent those of the two limbs of the V. (2) The posterior limb of the posterior V is much diminished in elevation, and does not join its anterior limb at the apex on the external side of the crown. If we now examine the corresponding parts of another Dinoceratous Amblypod, a species referred by Mr. Osborn to the genus Loxolophodon (Fig. 8), we find the process carried still further. The crown has only two crests which approach each other but do not join at the apex on the inner side. The

FIG. 7.—*Bathyopsis fissidens* Cope (one of the Dinocerata), mandible anterior to the coronoid process; incisors and canines and first premolar lost from both sides, two-thirds nat. size, from above; *a*, from front. Original, from Wind River (? Bridger) of Wyoming. From Vol. III Rep. U. S. Geol. Survey Terrs., F. V. Hayden.

posterior limb of the posterior V has disappeared, and a small

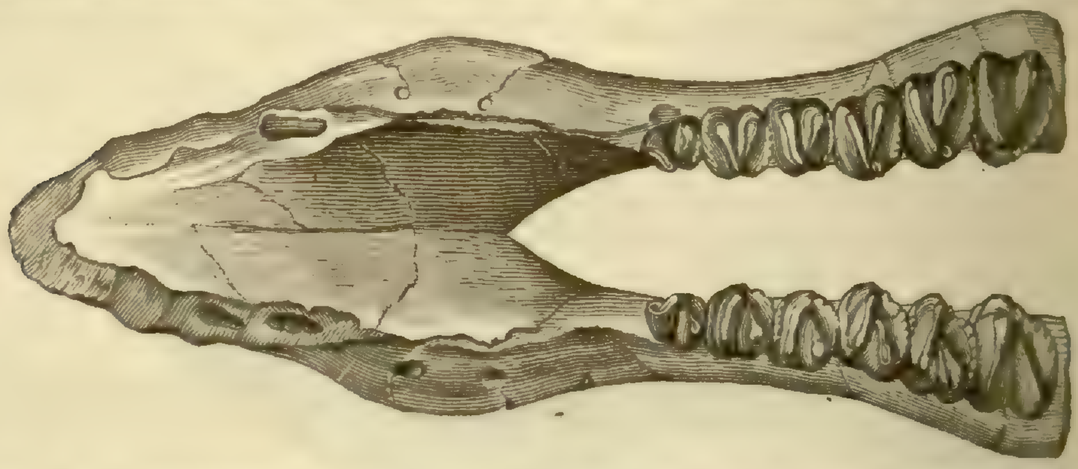


FIG. 8.—Loxolophodon sp., mandible anterior to coronoid process, one fourth nat. size; from Bridger beds of Wyoming. From Osborn, memoir on Loxolophodon and Uintatherium.

cusp represents the posterior crest of the anterior V.

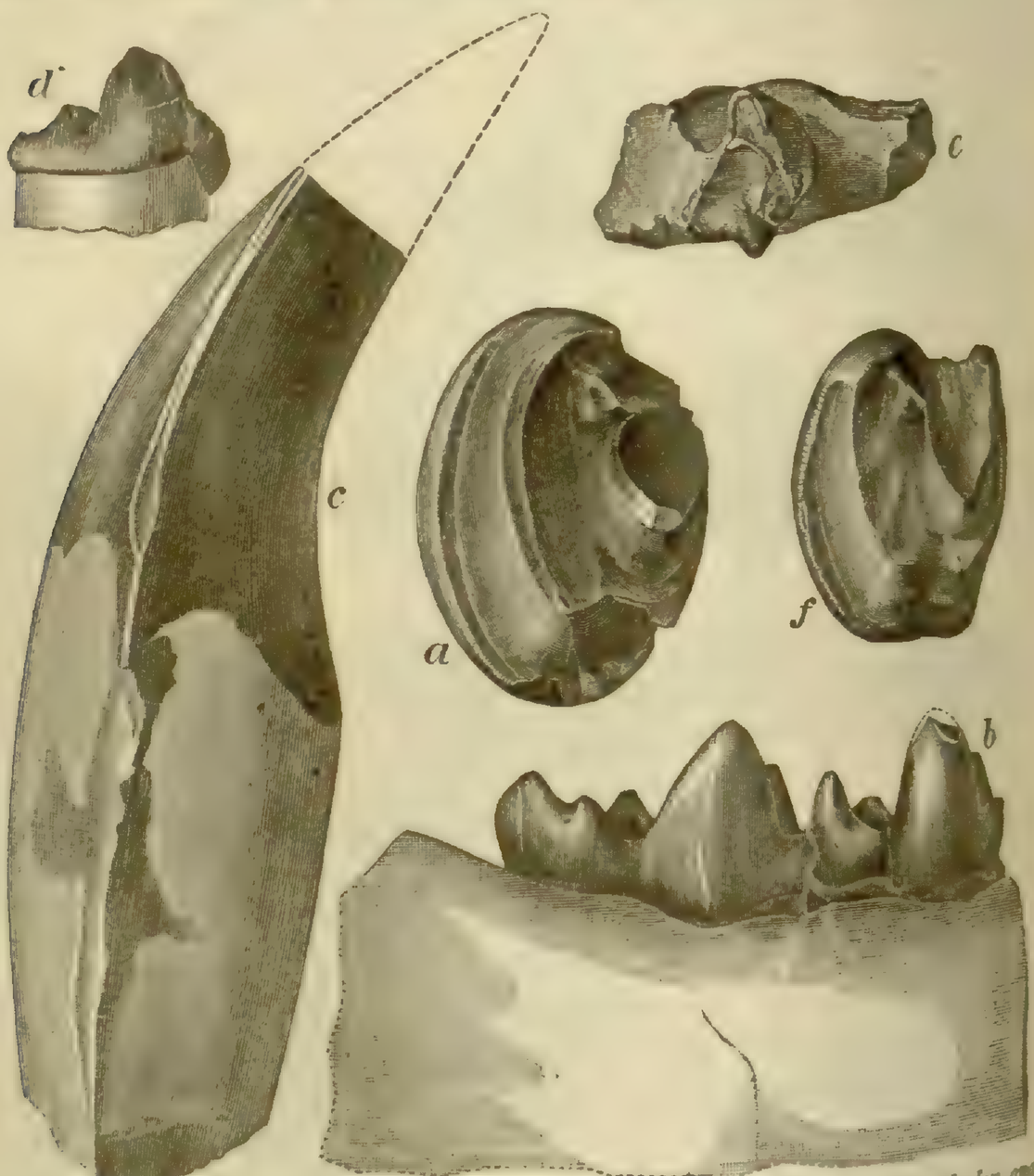


FIG. 9.—Teeth of Pantodonta, two-thirds nat. size. Figs. *a–d, Coryphodon anax* Cope; from the Wasatch beds of Wyoming. Original, from Vol. III Report U. S. Geol. Surv. Terrs. Fig. *e, Coryphodon cuspidatus* Cope, last inferior molar from above, anterior V broken; from New Mexico. Report U. S. G. G. Survey W. 100th mer., G. M. Wheeler, original. Fig. *f*, last superior molar of *Manteodon quadratus* Cope, from below; from Wyoming. Original, from Vol. III Report U. S. Geol. Surv. Terrs., F. V. Hayden in charge.

Let us now compare the superior molars of Pantolambda (Fig. 3) with those of Coryphodon (Fig. 9 *a*). The two external Vs of the former are represented in the latter by a cusp and a partial V, which form an oblique ridge on the external half of the posterior side of the tooth. This arrangement is already imitated on the last molar of Pantolambda, where one of the Vs has disappeared, and the one that remains is very oblique.

The second V preserves its form better in the superior molar of *Manteodon quadratus* (Fig. 9 *f*); while in the genus Metalophodon Cope, it is reduced to a cusp, forming the inner extremity of a transverse crest. (A figure of this genus will be given in the next number of the NATURALIST.) The interior V of Pantolambda is represented by a corresponding angle at the inner side of the crown in Coryphodon (Fig. 9 *a*), and the two ridges which connect it with the external base of the crown are well marked. Besides these there is developed on the anterior side of the base a strong cingulum. This is wanting on the posterior side, but is present in a feeble form in Pantolambda (Fig. 3). I have sometimes called these the superior and inferior anterior cingula respectively. In Coryphodon the posterior superior cingulum is unsymmetrically bulged near its interior end, and in Manteodon it develops a cusp at this point, the crown thus becoming quadritubercular (Fig. 9 *f*).

FIG. 10.—Dinocerata teeth, one-fourth nat. size. Upper figures superior molars of *Uintatherium leidianum*, one-fourth nat. size. Lower figure, inferior molars of jaw of Loxolophodon represented in fig. 8. From Osborn, memoir on Uintatherium and Loxolophodon.

If we now compare these teeth with those of Uintatherium (Fig. 10) we have little difficulty in determining the presence of the two anterior cingula. The difficulty is to ascertain the homology of the posterior transverse crest. It is difficult to see in it the two external Vs of Pantolambda confluent into a simple ridge, yet such it seems to be. This will be especially clear on comparison with the figure of Metalophodon. One is tempted to compare it with the posterier superior cingulum of Coryphodon, but the frequent presence

of a cusp posterior to its internal extremity in the Dinocerata presents a further obstacle to such a determination. This cusp is probably homologous with the posterior internal tubercle of Man-

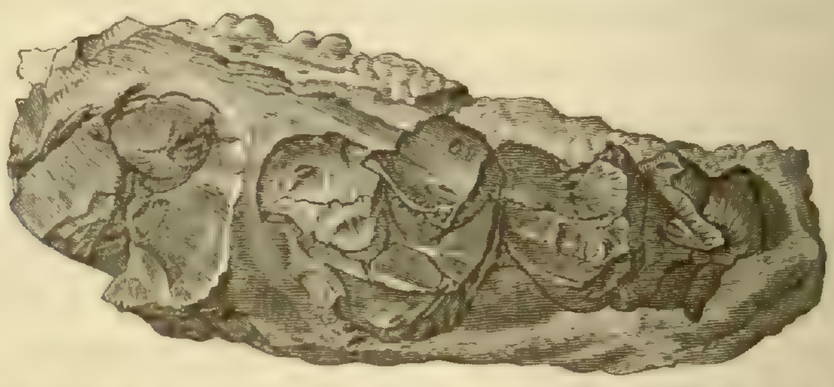


FIG 11.—Last three temporary molars, and first true molar partly protruded, of a Coryphodon from New Mexico, nat. size. Original, from Report U. S. G. G. Survey W. of 100th mer., G. M. Wheeler, Vol. IV, pt. II.

teodon (Fig. 9*f*), and is, therefore, the posterior internal of the quadrituberculate molar type. The internal extremity of the posterior crest of the crown in the Dinocerata cannot, therefore, be that cusp, and that ridge is not a posterior transverse crest, such as is present in most Perissodactyla.

It is interesting to observe that the fourth superior deciduous molar in Coryphodon (Fig. 11) has essentially the same structure as the true permanent molar of Pantolambda (Fig. 3).

The origin of the Amblypoda has not yet been traced. What was known on this point, as well as on the question of the descendants of the order, was stated as follows in my paper on the classification of the ungulate Mammalia, published in 1882:[1]

"As regards the inner part of the manus, I know of no genus which presents a type of carpus intermediate between that of the Taxeopoda and Amblypoda on the one hand, and the Perissodactyla and Artiodactyla on the other. Such will, however, probably be discovered. But the earliest Perissodactyla, as for instance Hyracotherium, Hyrachyus and Triplopus, possess the carpus of the later forms, Rhinoceros and Tapirus. The order Amblypoda occupies an interesting position between the two groups, for while it has the carpus of the primitive type, it has the tarsus of the later orders. The bones of the tarsus alternate, thus showing a decided advance on the Taxeopoda. This order is then less primitive than the latter, although in the form of its astragalus it no doubt retains some primitive peculiarities which none of the

[1]Palæontological Bulletin No. 35. Proceedings Amer. Philosoph. Society, 1882, p. 445.

known Taxeopoda possess. I refer to the absence of trochlea, a character which will yet be discovered in the Taxeopoda, I have no doubt.

"The Taxeopoda approach remarkably near the Bunotheria, and the unguiculate and ungulate orders are brought into the closest approximation in these representatives. In fact I know of nothing to distinguish the Condylarthra from the Mesodonta, but the ungulate and unguiculate characters of the two divisions. In the Creodonta this distinction is reduced to very small proportions, since the claws of Mesonyx are almost hoofs. Some of the genera of the Periptychidæ present resemblances to the Creodonta in their dentition also.

"The facts already adduced throw much light on the genealogy of the Ungulate Mammalia. The entire series has not yet been discovered, but we can with great probability supply the missing links. In 1874 I pointed[1] out the existence of a yet undiscovered type of Ungulata, which was ancestral to the Amblypoda, Proboscidea, Perissodactyla and Artiodactyla, indicating it by a star only in a genealogical table. This form was discovered in 1881, seven years later, in the Condylarthra. It was not until later[2] that I assumed that the Diplarthra are descendants of the Amblypoda, although not of either of the known orders, but of a theoretical division with bunodont teeth.[3] That such a group has existed is rendered extremely probable in view of the existence of the bunodont Proboscidea and Condylartha. That the Taxeopoda was the ancestor of this hypothetical group, as well as of the Proboscidea, is extremely probable. But here again neither of the suborders of this group represent exactly the ancestors of the known Amblypoda, which have an especially primitive form of the astragalus not found in the former. In the absence of an ankle joint the Amblypoda are more primitive than any other division of the Ungulata, and their ancestors are not likely to have been more specialized than they. It is probable that a third suborder of Taxeopoda has existed which had no trochlea of the astragalus, which I call provisionally by the name of Platyarthra.

"The preceding paragraphs were written in May, 1882. On

[1] Homologies and Origin of Teeth, etc., Journal Academy Nat. Science, Philada., 1874, p. 20.

[2] Report U. S. Geol. Survey W. of 100th mer., p. 582, 1877.

[3] This hypothetical suborder has been called Amblypoda Hyolonta.

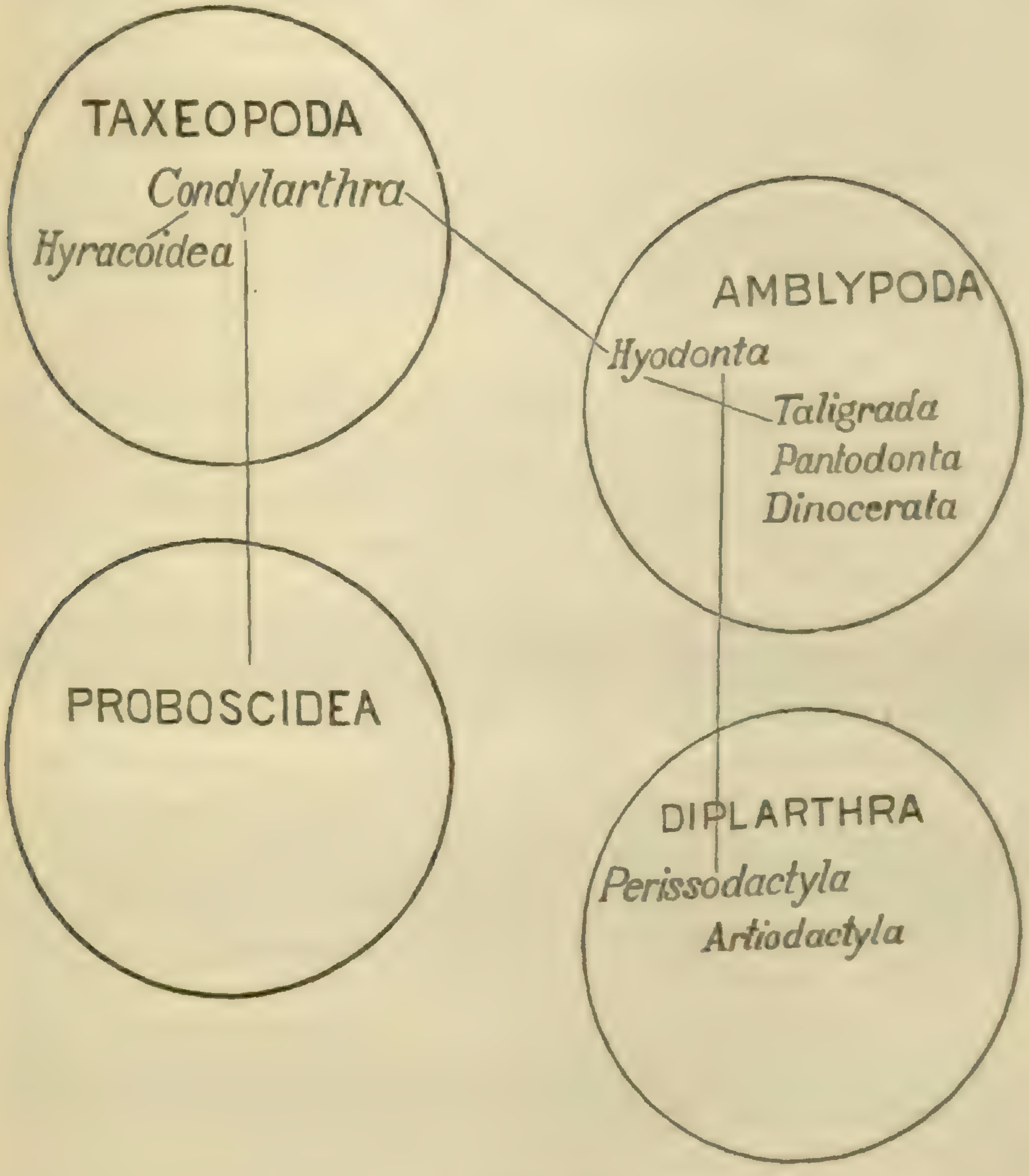
my return home, September 1st, after an absence of three months I find that various parts of the skeleton of Periptychus have reached my museum.[1] On examination I find that the astragalus of that genus fulfills the anticipation above expressed. *It is without trochlea,* and nearly resembles that of Elephas. As it agrees nearly with that of Phenacodus in other respects, I only separate it as a family from the Phenacodontidæ. One other type remains to be discovered which shall connect the Periptychidæ and the hypothetical Hyodonta, and that is a taxeopod without a head to the astragalus—unless, indeed, the 'Hyodonta' should prove to have such a head. I think the latter the less probable hypothesis, and hence retain the term Platyarthra for the hypothetical taxeopod without trochlea or head of the astragalus." This group as at first defined had been already discovered, but in the above paragraph I added another definition, endeavoring to preserve an apparently useless name.

The existence of Amblypoda Hyodonta is rendered almost certain by the discovery that the genus Pantolestes of the Wasatch epoch is an artiodactyle with tritubercular bunodont superior molars. The ancestral type of such a form must have been a tritubercular bunodont amblypod. Pantolambda is such a form with the tubercles modified into Vs. Moreover, such a type (Amblypoda Hyodonta) would be derived from a periptychid Taxeopod with but little modification of the latter. A distinct facetting of the astragalus for the cuboid bone, and *probably* a change of the carpus by an articulation of the unciform and lunar bones would be all that would be necessary. The discovery of Pantolambda has increased the probability of such change having taken place in the hind foot, since *the astragalus is intermediate in form between those of Coryphodon and Periptychus.* This is particularly seen in the form of the head, which is not separated by a neck as in Periptychus, but is more prominent than in other Amblypods (Fig. 3). Thus it is possible that Amblypoda Hyodonta will be found to have a short head of the astragalus, contrary to my supposition above expressed. The headless astragulas of other Amblypoda and of Proboscidea is perhaps a derivative and not a primitive character.

The following diagram gives expression to these views as to the phylogeny of the ungulates. It is the same that I published

[1] See NATURALIST for August, 1884, for figures.

in 1882 in the paper above quoted, modified so as to be more intelligible:



(To be continued.)

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The American Association for the Advancement of Science met this year in Philadelphia, between September 4th and 11th, inclusive. Omitting Saturday, which was given up to excursions, and Sunday, there were six and a-half days of work. The first of these was devoted to the addresses of welcome, and those of the vice-presidents, or chairmen of the sections. The

members in attendance were more numerous than at any previous meeting, rising to about 1300. Of these about 300 were members of the British Association, which adjourned at Montreal a day before the American Association convened. About 300 papers were read, and their average of excellence was comparatively high. Some of the best were read by our foreign guests. A few excellent papers were read by ladies, notably in the chemical, biological and anthropological sections. The address of the retiring president, Professor C. A. Young, treated of the great problems of celestial physics, and will prove both informing and stimulating to a wide circle of readers. The arrangements made by the local committee were admirable. The only drawback to the complete success of the meeting was the sickness of the distinguished president, Professor Lesley, which prevented him from taking part in many of the meetings. The postponement of the Congress of Geologists which was to have been held this year in Berlin, prevented immediate action on the question of an international scientific association. The committee having the subject in charge was continued and enlarged. Committees on the investigation of parasitic plant diseases, on the nomenclature of the brain, on methods of presenting statistics, and on ferments, were appointed. Propositions to meet, at some future time, in Toronto, Canada, and London, England, were brought forward for future consideration. The convention adjourned to meet next year at Bar Harbor, Me., or at Ann Arbor, Mich., as an alternative. In spite of the high temperature which prevailed, being much of the time above 90° F., the meeting was an enjoyable one, and the citizens of Philadelphia will reap some permanent benefit from its occurrence among them.

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RECENT LITERATURE.

FORBES' SECOND REPORT OF THE NOXIOUS INSECTS OF ILLINOIS[1]—This excellent report is like Mr. Forbes' first one, replete in original matter with full references to the work of his predecessors, so far as it is useful to his readers, and with good illustrations, some of them borrowed, while the table of contents and index are full and detailed. The arrangement and style are plain, simple and to the point. The report is mainly devoted to an

[1] *Thirteenth Report of the State Entomologist on the noxious and beneficial Insects of the State of Illinois.* Second annual report of S. A. FORBES, for the year 1883; Springfield, Ill., April, 1884. 8vo, pp. 205, XXIII, 15 plates.

account of all insects known to be in any way destructive to the strawberry, but also contains accounts of the wheat-bulb worm, the wheat straw worm, notes on insects affecting sorghum and broom-corn. The black-headed grass maggot, a species of Sciara, is also described, the fly not having been bred. The report closes with notes on the black fruit weevil, on the green apple-leaf hopper and the lesser apple-leaf folder. The life-histories of the following insects are new to science: *Meromyza americana*, *Cacœcia obsoletana*, *Lygus lineolaris*, *Deræocoris rapidus*, *Scelodonta pubescens*. The new species described are *Calinius meromyzæ*, *Choitophorus flavus* and *Siphonophora minor*.

The field work, the laboratory researches and the practical hints in this report offer little subject of criticism. It is to be hoped that a long series of such reports will be issued by the State, as those which have thus far appeared are in every way creditable to the State and its entomologist, and we know they are duly appreciated by the entomological and horticultural public.

Catalogue of Aquatic Mammals of the United States.[1] By F. W. True.—This paper includes a catalogue of the species of Cetacea, Sirenia and Pinnipedia of the coasts of North America, with notes and some observations on their distribution and habits. It will be found useful to mammalogists and other students of the subject. American cetology has lagged behind other departments for two reasons. It was first undertaken by the reviewer, who went to much expense and labor in collecting skeletons of whales and other forms. These were unfortunately presented to the Philadelphia Academy of Natural Sciences, and the department falling into incompetent hands, the material became practically inaccessible, so that the project of working up the subject had to be abandoned. The writer has long felt that he owed this explanation to the cultivators of the subject, in order to account for the very imperfect condition in which he left the literature, and also for the fact that some of the material is not now to be found. The second cause of the delay has been the ill health of Professor J. A. Allen, of Cambridge, who took up the subject next. We hope that Mr. Allen will be able to resume the pen which he laid down too soon for the good of American science.

A few points in Dr. True's catalogue admit of criticism. In referring to the type specimen of the *Megaptera osphyia* Cope, he says that in mounting the specimen all the vertebræ, except the atlas, have been reversed. He then adds, "I am convinced, from careful measurements, that the great height of the dorsal and lumbar neural spines, on which the species is mainly based, is a misapprehension," etc. The following quotation from my

[1] From the report of the United States exhibit in the International Fisheries Exhibition of London in 1883. Washington, 1884.

description of the species, shows that Dr. True is guilty of an inaccuracy as to the grounds on which the species was distinguished: "The shorter head and fins, the peculiarly high neural spines and peculiarities of the cervical vertebræ, would seem to distinguish this [species] from the *longimana*." I add that since my description was written, the museum at Niagara Falls, where the specimen is preserved, has been rebuilt, and the skeleton very probably remounted by an inexperienced person.

Dr. True and others are correct in the supposition that my *Hyperoödon semijunctus* is a Ziphius, as I have known for a long time, and had supposed I had published. The *Agaphelus gibbosus* must be withdrawn from the list of authentic species. The bones which I referred to it are probably those of *Balænoptera rostrata*. The characters of the animal in the flesh were given me by persons whom I supposed to be trustworthy, but who may have been mistaken. The species may, however, be the *Balæna gibbosa* of the old authors. Dr. True is not always consistent in his nomenclature. Thus he adopts the name *Phocæna brachyrhina* the first name of the species which was published with a description. The species had previously been named *P. americana* without description. The history of the name *Balæna cisarctica* is the same. It was first described under this name, though it had probably already received the catalogue name *B. biscayensis*, without description. Dr. True adopts the latter name. The name *B. cisarctica* should, by the rules of nomenclature, be allowed to stand, and is also much the better one. It has been adopted by American authorities, as Gill, Allen, Holder, etc.—*E. D. Cope.*

Winchell's Report on the Geology of Minnesota.[1]—The more notable features of this annual report are Steng and Kloos' paper on the crystalline rocks of Minnesota, which is dated Giessen and Hanover, August, 1876. Besides presenting notes of rock outcrops in Central Minnesota, Mr. Warren Upham reports on the glacial lake, Agassiz, the area and depth of which are thus described, its old beaches being well described and indicated on a map: "When this glacial lake attained its greatest extent just before it found an outlet into Hudson bay, over the melting ice-sheet, its length from south to north was probably greater than Lake Superior; but its area was only half or two-thirds that of Lake Superior because of its less average width. At the time of the formation of its highest beach, the depth of Lake Agassiz above the Lake of the Woods was some 200 feet; above the Red River valley, at our northern boundary, 450; and above Lake Winnipeg about 600 feet."

Mr. Upham does not accept Gen. Warren's view that the drainage of this region was directed southward by an elevation of the land considerably above its present height north-east of Lake

[1] *The Geological and Natural History Survey of Minnesota.* The eleventh annual report for the year 1882. N. H. Winchell, State geologist. Minneapolis, 1883. 8vo, pp. 219, with two maps.

Winnipeg, but "that the surface of the continent had nearly the same form then as now, and that the continental ice-sheet, resting on the land in a solid mass of great depth, formed the northern shores of Lake Agassiz and was the barrier that prevented its flowing into Hudson bay."

On p. 138 is not Mr. Upham a little sweeping? Has transported drift been found on Mt. Katahdin above a point 3500 feet above the sea, and was the summit of Mt. Washington glaciated? The occurrence of the single boulder found by Professor Hitchcock scarcely proves so much as that.

THE STANDARD NATURAL HISTORY.—This work is being rapidly completed and appears to be well sustained in point of treat-

The Arctic Fox.

ment by the different contributors, as well as in illustrations, paper

and presswork. The seventeenth number finishes the chapter on Carnivora. The portion relating to the Arctoidea has been prepared by Rev. Samuel Lockwood, the other groups by Mr. W. N. Lockington; though these writers are not specialists in mam-

malogy they appear to have been accurate in their statements of facts.

The accompanying figures of the arctic fox and the coyote, which are, like most of the other illustrations, taken from Brehm, will give a fair idea of the nature and value of the illustrations in parts 14–17.

GEOLOGICAL SURVEY OF ALABAMA.[1]—The first quarter of this volume of more than six hundred pages is devoted to a tolerably full consideration of the soil in its chemical and geological relations, and its relations to vegetable and animal life, with an account of the various manures and of their suitableness and action upon different kinds of soil. The second and larger part treats of the main agricultural features of the State, including an outline of its physical geography and geology. The Coosa and Tennessee valleys, coal measures district, oak and pine uplands and other regions of the State are described in detail, a list of the characteristic plants of each region is given, and the work concludes with descriptions of the agricultural resources of the counties, and cultural and economic details of cotton production. An agricultural map and maps showing the rainfall, temperature, area planted in cotton, etc., add greatly to the usefulness of the work.

RECENT BOOKS AND PAMPHLETS.

Linnæan Soc. of New York.—Transactions of the Linnæan Society of New York. Vols. I and II, 1883–'4. From the society.

Collett, J.—Geology and Natural History of Indiana. 13th report, 1883. Part I. Geology and Natural History; Part II. Palæontology. From the State geologist.

Lacy, W. M.—An examination of the philosophy of the unknowable, as expounded by Herbert Spencer. 1883. From the author.

Beecher, C. E.—Ceratiocaridæ from the Chemung and Waverly groups at Warren, Pennsylvania. Harrisburg, 1884. From the author.

Thominot, A.—Sur un Mabuya d'espèce nouvelle, also Note sur un poisson de les famille des Cyprinodontidæ. Ext. du Bulletin de la Soc. Philomathique de Paris, Mars, 1881. From the author.

Lydekker, R.—Mem. Geol. Surv. India. Palæontologia Indica, Ser. x, Vol. III. Part. 3. Rodents and new ruminants from the Siwaliks, and Synopsis of Mammalia. Calcutta, 1884. From the author.

Hasse, C., Kliver, M., Schlosser, M., Schenk, A.— Palæontographica. Beiträge zur Naturgeschichte der Vorzeit, Part CXXXVI. Cassel, 1884. From M. Schlosser

Schlosser, M.—Die Nager de europäischen Tertiärs nebst Betrachungen über die Organisation und die geschichtliche Entwicklung der Nager überhaupt. Cassel, 1884. From the author.

Guldberg, G. A.—Sur l'existence d'une quatrième espèce du genre Balænoptera dans les mers septentrionalis de l'Europe. Ext. du Bulletin Acad. Roy. de Belg. 3me serie, tome VII, 1884.

——Sur la présence, aux temps anciens et modernes de la baleine de Biscaye (ou Nordcaper) sur les côtes de Norwège. Ext. idem. Both from the author.

Wadsworth, M. E.—Methods of instruction in Mineralogy. Abs. of paper read before Soc Nat. E. U. S., Dec. 27, 1883, also letter to Science, Aug. 8, 1884.

——Notes on the rocks and ore-deposits in the vicinity of Notre Dame bay, Newfoundland. Ext. Am. Jour. of Science, Vol. XXVIII, Aug., 1884.

——The fortieth parallel rocks. Ext. Proc. Bost. Soc. Nat. Hist., Vol. XXII, Oct., 1883.

——On the evidence that the Earth's interior is solid. Ext. Amer. Nat., June, 1884. All from the author.

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[1] *Geological Survey of Alabama.* Report for the years 1881 and 1882. By EUGENE ALLEN SMITH, Ph.D., State geologist. 1883.

Albrecht, P.—Sur les spondylocentres épipituitaires du crane, la non-existence de la poche de Rathke, et la presence de la chorde dorsale et de spondylocentres dans la cartilage de la cloison du nez de vertebrés. Bruxelles, 1884.

——Sur le valeur morphologique de la trompe d'Eustache et les derives de l'arc mandibulaire et de l'arc hyoidien. Both from the author.

Jordan, D. S., and Swain, J.—Descriptions of Scaroid fishes from Havana and Key West, including five new species. Ext. Proc. U. S. Nat. Mus. From the authors.

Putnam, F. W.—Remarks on the antiquity of Man in America. Rep. Proc. Amer. Ant. Soc., April 30, 1884. From the author.

Lawrence, G. N.—Characters of a new species of Pigeon of the genus Engyptila from the Island of Grenada, W. I. From the Auk, Vol. 1, No. 2, April, 1884.

——Descriptions of new species of birds of the genera Chrysotis, Formicivora and Spermophila. Both from the author.

Milne-Edwards, A.—L'Expedition du Talisman faite dans l'Ocean Atlantique. Extr. du Bull. hebdom. de l'Assoc. Sci. de France, Dec., 1883. From the author.

Ryder, J. A.—On the preservation of embryonic materials and small organisms with hints on mounting and imbedding sections. 1884. From the author.

Allen, H.—Allen's Human Anatomy. Section VI. Organs of sense, organs of digestion and genito urinary organs. Phila., 1884. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Recent Travels in Arabia.*—No more adventurous journey has been undertaken for many years than that of Mr. C. M. Doughty through the heart of Arabia, among wild Bedouins who had never previously been visited by an *Engleysy* and *Nasarany*, an Englishman and a Christian, as our traveler freely avowed himself to be. Although this honest avowal caused Mr. Doughty to be in peril of his life on more than one occasion, yet he made friends among the nomads, and claims that his bold course has been the means of making the name of Christian respectable, instead of abhorred, in the vast stretch of country traversed by him.

In the early part of 1875 Mr. Doughty was at Petra, the remains of which he believes to be those of a few public halls or temples, and of sepulchres, while the city itself, probably built of clay, has disappeared. He was asked by the villagers whether he had seen the similar remains at Medyin Salih, ten journeys distant by the Haj or pilgrimage road from Maan, a station near Petra. He at once formed the resolution to visit these ruins, and in the autumn of 1876 accompanied the Haj to the spot. Medyin Salih is a level plain, sixteen miles long and as many broad, surrounded by sandstone precipices, and the ruins lie about a mile from the garrisoned station. The name signifies cities of Salih, who, according to Arab tradition, was a prophet who preached to the unbelieving people of Hel-Hejr until a judgment fell on them.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Hejr, or Hejra, was an emporium on the old gold and frankincense road of the Sabaeans. The houses, probably of clay, have vanished, and their site is marked only by bits of broken glass and pottery; but the sepulchral chambers, hewn out in the soft sandstone cliffs, still remain. The façades, full of cornices and pilasters, show a strange mingling of Egyptian and Greek. On the top of each is the stepped ornament so common at Petra. The pediments usually have at their sides urn-like ornaments, others have griffin-like figures. In some cases the tympanum has a man's head with the braided side-locks now called "horns" by the Arabians. In a gorge near by is a hall (the only excavated chamber not a sepulchre) with a number of engraved tablets. The inscriptions are in a Nabathean-like character.

Eleven miles further south, near the village of el-Ally, was the site of another old town. Here were a number of other inscriptions, not Nabathean but Himyaric in character. Baith Naam is the name handed down by tradition, and Mr. Doughty suggests that it may be the Badanatha of Pliny.

The "Harra" of Arabia is the "butte" of our own arid regions, a platform of sandstone preserved from erosion by a capping of basaltic lava. In one of these to the north of Medyin Salih the lava attains a depth of more than a hundred fathoms. The platform is studded with craters at the summits of cones rising from 200 to 600 or 700 feet. The highest, Jebel Anaz, rises 1000 feet or more.

Teyma is a village on the site of an ancient city of the same name. The houses are gone, but the old city wall, three miles around, still stands, together with the remains of some columns. Inscriptions were found here in a character which Sir H. Rawlinson thought to be allied to the Phœnician. The next spot examined after a vist to Hayil was Khaybar, which was reached by traversing another Harra known as the Harrat Khaybar. Near the middle of this region the altitude is nearly 6000 feet, and this Harra is the water-parting between east and west in Northern Arabia, the waters running eastwards in the great trough known as Wady-e'-Rumma, and westwards into the Wady-el-Humth. The former has long been known, but Mr. Doughty found its head near the villages of Hayat and Howeyat, while its mouth is at Sheyor, near Bosra, so that if it were a stream instead of a dry trough, it would be an affluent of the Euphrates. The Wady-el-Humth was previously unknown to geographers. Its head is in the steppes beside Tayif, and its mouth on the Red sea, between el-Wejh and el-Haura. Boreyda and Aneysa, the two largest towns in Nejd, have a population respectively of 5000 and 7000.

On his way from Aneysa to Jidda, in company with a caravan laden with *samma* or clarified butter, Mr. Doughty saw, on an elevated steppe on a basis of granite, the best natural pasture he

had seen in Arabia. The presence of the pastures is due to annual tropical rains, which fall for five or six weeks together, commencing at the end of August or the beginning of September. This region is occupied by the great Bedouin nation, Ateyba. In the last days of the journey the caravan passed alongside of the great southern Harras, where the lava had been poured out upon granite.

Arabia is a land of sepulchres and ruins. The modern Arab neither bores deep wells and builds stone houses, as did the ancient Arabians, nor even builds of clay and constructs dams, as in a more recent age. Among the most ancient remains are huge erect stones such as in England would be called Druidical, and buildings of huge Cyclopean blocks. The façades at el-Hejr are thought by Mr. Doughty to date from the earlier centuries of the Christian era. Barrows of prehistoric or uncertain age are numerous. Mr. Doughty has made drawings of three renowned idol-stones of the ancient Arabians. He also discovered an antelope which is new to science, and lives in the sandy deserts of Sherrarat, Kahtan and Muna.

The geology of Arabia is simple. A central cone of Plutonic rocks is overlaid by sandstones, and these again by limestones, sometimes with flints. The latter rocks, which appear again between the Dead sea and Jerusalem, are, Mr. Doughty believes, of nearly the same age as the chalk, while the underlying sandstones represent the greensand.

Mr. Doughty's journey was concluded in the autumn of 1878, although his account of his adventures is comparatively recent. A year ago the celebrated orientalist, Professor Julius Euting, traversed much of the same ground, discovered a large Aramaic column at Teyma, and obtained numerous inscriptions at Medyan Salih and El Ally; but a report spread among the Bedouins that his box of copies of inscriptions contained pure gold, and he with difficulty saved his life. He previously discovered a hitherto unknown Jewish temple at Palmyra.

Sir Charles W. Wilson's Notes in Anatolia.—Anatolia, or Central Asia Minor, is a plateau which rises gradually from 2500 feet in the west to some 4500 in the east, near the foot of the Anti-Taurus. The Taurus range, which in some places rises little higher than the plateau, but in others, as in the mountains of Lycia and the Bülghar Dagh, attains 7000 to 8000 feet, buttresses the table-land on the south; on the west the edge of the plateau is broken by numerous broad valleys, without any very great elevation; on the north-west rises the high range of the Mysian Olympus; on the north stretches a range of varying altitude without distinctive name; and on the east the Anti-Taurus supports a higher plateau that extends eastward to Erzerüm. Here and there minor ranges, as the Phrygian mountains and the Sul-

Dagh, rise above the general level, and there are some remarkable mountains of volcanic origin, among which Mount Argaeus, near Kaiserieh, is the loftiest and best known (13,000 feet).

The streams of the central and southern part of the plateau are lost in salt lakes, or supply fresh-water lakes, the waters of which find their way beneath the Taurus and reappear as noble streams running to the south coast. Thus the waters of Eregli lake reappear as the sources of the Cydnus, whilst those of the large lakes, Beyshehr and Egirdir, swell the volume of the Melas and the Eurymedon. Many hot springs occur, marked often by the ruins of Roman baths, and still used by the Anatolians.

The climate is much like that of New England, cold in winter, hot in summer. On the south coast the winter is delightful. As three sides of the country are surrounded by water, there are three summer sea-breezes, from the north, west and south. These opposing breezes produce a calm belt of intense heat in the center. In winter intensely cold northern winds with torrents of rain and heavy falls of snow prevail. At the break-up of the winter a dry south wind rapidly thaws the snow, and by the evaporation produces a feeling of intense cold. Forests flourish most in the north, but the entire country has tracts which are nowhere surpassed for agricultural and fruit growing purposes. The enormous mineral wealth of the country, gold, silver, lead, iron, chrome, rock-salt, kaolin, etc., is as yet undeveloped.

It is usually supposed that Anatolia is the home of the Turks, but it seems as though whenever the modern so-called Turk is examined, he is found to be the descendant of the native races of the country, and to differ from the Christians of the region only in religion. In Anatolia the Galatian and Cappaduan are still well-marked. Since the Greek war of independence there has been a great movement of Greeks to the western sea coast, resulting in the almost entire displacement of the Moslem population. The so called Greeks of the interior are, however, of Pontic or Cappadocian origin. There are a few villages of true Turks in the Angora and Brusa districts; they occur also in the towns, and form most of the official class. Around the head of the Gulf of Scanderûn is a knot of mountains in the valleys between which flow the Cydnus (Teraus Chai), Sarus (Sihûn) and Pyramus (Jihûn). The Cydnus is formed by the junction of three streams which rise in deep gorges at the foot of the Taurus, here called the Bûlghar Dagh. The Sihûn is formed by the junction of the Samanti and Saris, the former of which runs to the west of the Anti-Taurus, while the latter pursues its course along the rich open valley which divides the twin ranges of the Anti-Taurus. The Jihûn, formed by the union of several streams, breaks through the Taurus by a deep gorge, and then, after traversing some open country, bends to the west, passes through a narrow defile between the Giaour Dagh and the Taurus, and enters the

Cilician plain, where it is joined by several important tributaries. The Giaour Dagh runs from the Taurus south-west to the Mediterranean south of the Gulf of Scanderûn. The great Cilician plains is thus enclosed by the Taurus and Giaour Dagh. The plain of Issus is parted off from it to the east by the hills of Jebel Nur east of the lower course of the Jihûn. The Cilician plain consists of a rich stoneless loam brought down by the rivers, but the plain of Issus is stony and uncultivated. The Giaour Dagh, the Ansariyeh mountains, Lebanon, and the hills of Western Palestine form one side of the great hollow in which lie the valleys of the Orontes, Leontes, and Jordan, with their continuations to the Red sea. The eastern wall of this depression is formed by the Kûrt-Dagh and the Anti-Lebanon. When the accounts of the movements of Darius and Alexander are compared with the topography of the plain of Issus, accessible only by three "gates," and narrow at its southern portion, it is probable that the Pinarus (on which Darius' army was encamped) is the stream which enters the sea south of Piyus.

GEOGRAPHICAL NOTES.—M. Aumoitte gives, in L'Exploration, a record of his journey from Hanoi through Bac-Ninh to Lang-Son, on the Chinese frontier. At the meeting of the provinces of Bac-Ninh and Lang-Son the country becomes mountainous, the roads are bad and the brigands have almost depopulated the district.——The first mail of the season from Kadiak brings the news that the eruption on Augustine island, Cook's inlet, was much exaggerated. The island was not split in two, nor was a new island formed, but the west side of the summit has fallen in, forming a new crater, and the entire island has risen so much that the only bay or boat harbor is filled up. The winter was mild, the lowest temperature was 10 F., and wild flowers were in bloom at the end of April.——Mr. Jos. Thomson reports that the region traversed by him from Mombasa to the north of Victoria Nyanza is entirely volcanic. One volcano, west of Kilimanjaro, shows signs of activity. Mount Kenia, though covered with trees, stands in a desert. The customs, dwellings, religion and language of the Masai, as well as their features, differ markedly from those of other African peoples known to Mr. Thomson.—The Bolletino of the Italian Geographical Society gives the regulations and programme of the first Italian Geographical Congress, which meets at Turin from Aug. 15 to 19. Among the subjects for discussion are, "What ethnological conclusions are to be drawn from recent anthropological and philological data regarding the indigenous populations of East Africa?" "What are the best means of organizing an independent Hatian Expedition to the Antarctic seas?" "On the need of preparatory schools for training travelers," and "On the importance of establishing commercial stations in the Barbary States as a means of gaining

access to the Sudan."——Mr. Holt Hallett and his party have reached Bangkok after an arduous journey of five months from Montmein. The work done comprises the surveying of over 1500 miles, the determination of the position of the Shan mountain ranges and a large series of observations of the vocabularies of the aboriginal races and the histories of the several Shan States. The expedition was everywhere well received, and has collected much information upon the interior of Indo-China.——The river Chandless, a tributary of the Purus, named after Mr. Chandless, who ascended the Purus in 1864 to a distance of 1866 miles from its mouth, was ascended last year by the Brazilian steamer *Santarem*. It flows from or through a large lake.——Mr. H. O. Forbes is making arrangements to visit Southeastern New Guinea.——Further notes of the travels of M. Giraud states that Lake Bangweolo proved to be only an immense morass. The Luapula flows out of the south side of the lake, and describes a long curve to the south and west for 100 miles before taking its definite northerly course. At the bend he was stopped by a great cataract, named Mombuttuta, and by hostile natives who made his party prisoners and seized his boat. After two months he escaped and joined his caravan, which he had sent on to Cazembe, but here again he was plundered of his stores and most of his carbines. After narrowly escaping death by hunger, he reached the station of the London Missionary Society, at Lake Tanganyika, and was aided to cross to Karema. He describes Lake Maero as a large and beautiful lake, with high banks. He will resume his journey as soon as his stores are replenished.—— After the departure of Lieut. Wissmann, the late Dr. Pogge returned to Tushilange Land, where he remained until November 9th, 1883, when, as no news reached him, and his means were nearly exhausted, he decided to return to the west coast. From a letter which he wrote at Malange, February 2d, 1884, it appears that before crossing the Kassai, he made a detour northward, and found that the Lulua joins that river five days march north of Mofuka. He then proceeded parallel to the Kassai as far as Kikassa, where he crossed the river, going south-westward across the Loange, Quilu, and Ohamba. He had scarcely reached St. Paul de Loanda when he was attacked by inflammation of the lungs, and died March, 10th, 1884.——The Danish government has sent Lieut. Jansen and Herr Lorenzen to explore the outskirting land of Greenland, between Holsteinburg and Sukkertoppen, a part as yet unvisited by Europeans. An expedition to the east coast of Greenland will be undertaken by Lieut. Holm.—— The country of the Phou'ons, situated between Tongking and Laos, on the upper waters of the Song-Câ and Song-Pho, tributaries of the Gulf of Tonking, and on the upper parts of the Nam-Sam and Nam-Muon, affluents of the Mekong, has during the last ten years suffered much from the invasions of the Hòs or

Chinese, who are driven onwards by the misery and excess of population that exists in the southern provinces of China.—Sir Buonfanti, in his recent expedition across North Africa, was compelled to desist from his attempt to penetrate the unexplored region south of Adamawa, and finally, making his way to the Niger at Say, midway between Timbuktu and the Binue confluence, ascended the river to the former place. As this feat, before believed impossible, was performed in the dry season, the fact has considerable commercial importance. From Timbuktu the explorer passed through Massina and Bambarra to the almost unknown territory of Tombo, where the expedition was plundered and dispersed. After great sufferings, Sir Buonfanti reached a Catholic mission in the Bussanga country north of Dahomey.—In the western part of the Straits of Magellan glaciers exist on the slopes of a range of mountains the highest peaks of which are not above 4500 feet. The winds from the Pacific, eternally blowing from the west, and full of moisture, keep up a constant condensation, and the glaciers exist wherever the broken ground allows them a foot hold. The largest observed by Mr. W. J. L. Wharton was the Northbrook glacier, with an area of from fifty to seventy square miles.——The Russian government has under consideration a plan for an expedition to the North Pole. Depots will be established at the Jeannette, Bennett and Henriette islands. From these islands the journey will be continued to Franz-Josef Land by steamer, and thence on sledges and on foot.

GEOLOGY AND PALÆONTOLOGY.

Blanford on Homotaxis of Geologic Periods.—In his address before the British Association for the Advancement of Science at Montreal, Mr. W. T. Blanford devoted considerable attention to some remarkable exceptions to the rule that similarity of faunas and floras in fossiliferous formations throughout the surface of the world implies identity of geological age.

Some interesting contributions have been made to this question by the geological survey of India, where Mr. Blanford's experience has been chiefly derived, and by the geologists of Australia and South Africa; and he first noticed a few typical instances, several of them Indian, in which the system of determining the age of various formations by the fauna or flora has led to contradictory results, and then showed where the source of error appears to lie. The famous Pikermi beds of Greece, a few miles east of Athens, contain a vertebrate fauna nearly always quoted as Miocene; but they overlie strata with well-proved Pliocene marine Mollusca. The Siwalik beds that flank the Himalaya north of Delhi are still classed as Miocene by most European writers, but are regarded as Pliocene by the Indian survey, on evidence found by tracing them west and south into Sind. The

Gondwána system of Central India, a great sequence of fresh-water beds probably of fluviatile origin, over 20,000 feet thick, is of unusual interest on account of the extraordinary conflict of palæontological evidence it presents.

Its subdivisions are numerous, and vary in almost every place of occurrence. One (the Tálchir beds) contains rounded boulders chiefly of metamorphic rocks up to six feet across, embedded in fine silt, others are characterized by an intermingling of floras and faunas that give rise to a mass of contradictions; beds with a Triassic fauna overlying others with Rhætic or Jurassic floras. The Australian coal-measures and their associated beds present even a more remarkable instance of homotaxial perversity, a Jurassic flora being of the same age as a carboniferous marine fauna. Some of these beds (Hawkesbury) again contain transported boulders, which occur once more in the lower members (Ecca beds) of the Karoo formation of interior South Africa. The latter presents a striking likeness to the Gondwána system of India. In both countries a thick fresh-water formation occupies a large area of the interior of the country, whilst on the coast some marine Jurassic and Cretaceous rocks are found; and as in India, so in South Africa, the uppermost inland Mesozoic fresh-water beds are capped by volcanic.

Other examples of discrepancies in palæontological evidence might be given, but he would add merely a mention of the single case known to him in which the discordant records are both marine, namely, Barrande's "colonies" in Bohemia; but here the discordance is much less than in the cases before cited, and moreover, Barrande's conclusion is disputed by other observers.

In most of the cases he had named the conflict is between the evidence of marine and terrestrial organisms. Manifestly one or the other of these leads to erroneous conclusions, and in making choice between the two, most geologists accept evidence of the marine fossils. The reason is not far to seek. So far as he was aware, no case is known where such an anomaly as that displayed in the Gondwánas of India has been detected amongst marine formations of which the sequence was unquestioned. Further, if we compare the distribution of marine with that of terrestrial and fresh-water animals and plants at the present day, we shall find a very striking difference; and it is possible that this difference may afford a clew to the conditions that prevailed in past times.

The idea that marine and terrestrial faunas and floras were similar throughout the world's surface in past times, is so ingrained in palæontological science that it will require many years yet before the fallacy of the assumption is generally admitted. No circumstance has contributed more widely to the belief than the supposed universal diffusion of the carboniferous flora. The evidence that the plants which prevailed in the coal-measures of Europe were replaced by totally different forms in Australia, de-

spite the closest similarity in the marine inhabitants of the two areas at the period, will probably go far to give the death blow to an hypothesis that rests upon no solid ground of observation. In a vast number of instances it has been assumed that similarity between fossil terrestrial faunas and floras proves identity of geological age; and by arguing in a vicious circle, the occurrence of similar types, assumed without sufficient proof to belong to the same geological period, has been alleged as evidence of the existence of similar forms in distant countries at the same time.—*Science.*

THE GLACIERS OF NEW ZEALAND.—The June issue of *Petermann's Mittheilungen* is occupied with an elaborate description of the Tasman glacier of New Zealand, and of its surroundings, by Dr. R. V. Lendenfeld. A map is given of the central part of the Alpine region of New Zealand, showing the glaciers, water-parings, rivers and lakes. Of these glaciers the Tasman descends lowest, the river of the same name flowing from its foot at an elevation of 730 meters. From the foot of Murchison glacier (1120) meters, the Murchison river flows beside the lower part of the Tasman glacier, and unites with the Tasman river near its foot. A little lower down the Tasman river is joined by the Hooker, flowing from the foot of Hooker glaciers (802 meters). The network of streams forming the Tasman debouch in Lake Pukaki at an elevation of 523 meters. From the Godley glacier, at an elevation of 1031 meters, flows the Godley, which uniting with the McCauley from an elevation of 1333 meters, forms Lake Tekapo at a height of 743 meters. This lake receives also the Cass, flowing from the foot of the Huxley glacier. The Tekapo and Pukaki, flowing from the lakes of the same names, unite to form the Waitangi, which receives also the Ohau, itself the offspring of the Hourglass and Richardson glaciers in 1163 and 1239 meters respectively, and the Ahuriri. The Wanganui, Wataroa, Waiau, Weheka and Karangarua flow from the glaciers to the western coast. The rivers and glaciers of the western side of the Alps are shorter and smaller than those of the eastern side. The Tasman glacier is twenty-eight kilometers long, and is the largest of the glaciers of New Zealand.

THE ORIGIN OF THE MAMMALIA.[1]—The question as to the origin of the Mammalia has remained unsettled, and speculations have been divided as to whether the class has arisen by a modification of the Batrachia or of the Reptilia. Although there are cogent reasons why the descent should be from the former class, the evidence obtained up to this time from palæontology is in favor of the hypothesis of derivation from the Reptilia. The first evidence of this kind has been empirical and not conclusive.

[1] Synopsis of a paper read before the Amer. Assoc. Adv. Sci., Phila., 1884.

This consisted in the characters derived from the long bones of the limbs. Professor Owen first called attention to this resemblance in the genus Cynodraco, which is a Theromorph reptile. I next pointed out corresponding peculiarities in the bones of the American Theromorphs. I afterwards showed the resemblance between the pelvis of the Pelycosaur division and that of the Monotremata. This was followed by a demonstration of the resemblance between the coracoid of the Pelycosauria and the Mammalia Monotremata, especially to that of the genus Platypus. The present note now adds that the structure of the posterior foot approaches near to that of the Monotremata in having distinct navicular and cuboid bones, and that the astragalus and calcaneum are essentially like the corresponding part in the *Platypus anatinus*. The last two points are essential and fundamental. The three great distinctions between the Mammalia and the Reptilia in the skeleton are: (1) In the quadrate bone; (2) in the coracoid bone, and (3) in the occipital condyle. Of these the first is of less importance than has been believed, if, as maintained by Peters and others, it is to be excluded from the series of ear-bones. Its relations to the zygomatic arch in some Pelycosauria look as if Albrecht's view, that it represents part of the squamosal bone of Mammalia, is correct. The last character is weakened in importance by the fact that in some of the geckoes the condyle is double, which is due to the reduction of the basioccipital element and development of the occipital, thus agreeing fundamentally with the Mammalian condyle. The only interruption in the series which has not yet been overcome, is in the columella auris. No reptile is yet known where that element is divided into incus, orbicularis, and stapes as in the Mammalia and some Batrachia (according to Albrecht). Nevertheless the supposed columella auris, in some of the Pelycosauria, is divided at the end, so as to have two proximal termini, one of which may represent the incus. The malleus is distinct and is united by suture with the columella. In fact, most of the characters of the Batrachia, which have been cited by Huxley as indicative of the descent of Mammalia from that class, are found in the Pelycosaurian Reptilia. We give figures of these parts in the December NATURALIST.—*E. D. Cope.*

BEECHER'S CERATIOCARIDÆ OF PENNSYLVANIA.—This brochure, by Mr. C. E. Beecher, comprises descriptions of such Phyllocaridans as constitute the family Ceratiocaridæ, which have been collected in the rocks of the Chemung and Waverly groups of Pennsylvania, and is extracted from report of progress PPP, 2d geological survey of that State. Several new forms are described and well figured, and considerable structural details relating to the genus Echinocaris of Whitfield, with excellent figures on two plates. Special attention is called to the terminology, which is

illustrated by a woodcut; while a table is added giving the geological range of the genera Echinocaris, Elymocaris and Tropidocaris.

Two new genera (Elymocaris) with a new species (*E. siliqua*), Tropidocaris with three species (*T. bicarinata*, *T. interrupta* and *T. alternata*) are described, also *Echinocaris socialis*, n. sp. The illustrations are excellent. Every distinct, well preserved form of this group is of the greatest interest, and good figures of them are of special value. The point of greatest value in the paper is the identification and illustration of the mandibles, as Mr Beecher claims them to be; they are very large, heavy and remarkably different from those of Nebalia, the existing type of the order.

NIAGARA FOSSILS.—Descriptions of a number of new species of Niagara fossils are published in the Bulletin of the Museum of the University of the State of Missouri, Vol. I, No. 1, dated May, 1884, and with the above title.

The paper is written by Professor J. W. Spencer, of the University of Missouri, and contains sixty-two pages and nine plates. It is divided into three parts, as follows: Part I. Graptolitidæ of the Upper Silurian system; Pt. II. Stromatoporidæ of the Upper Silurian system; Pt. III. Fifteen new species of Niagara fossils.

The great majority of the specimens upon which the new species are based are from the Niagara shaly dolomite rocks of Hamilton, Ontario, Canada, and the types are in the private collection of Professor Spencer.

Among the Graptolites twenty new species and one new genus are described: Phyllograptus? 1, Dendrograptus 6, Callograptus 3, Dictyonema 2, Calyptograptus 2, Acanthograptus 1, Inocaulis 5, Cyclograptus (a new genus) 1; one of the new species of the Dictyonema is from the Clinton group.

Four new species of Stromatoporidæ are described from the Niagara group at Hamilton, Ontario, one from Dalhousie, New Brunswick, from the "Lower Helderberg?" group; they belong to the genera Cannopora 2, Cœnostoma 2, Dictyostoma 1.

From the Hamilton, Ontario, beds fifteen new species belonging to the following genera, are described: Palæaster, Fenestella, Polypora, Rhinopora, Clathropora?, Lingula, Discina, Crania, Pleurotomaria, Conularia, Orthoceras, Cyrtoceras, Lituites.

In regard to the Graptolites the author remarks that, "In the following descriptions I have often been compelled to depend almost entirely upon the size of the stipes and mode of branching, as the cellular structure has been obliterated in the majority of cases, even where the general form of the frond is perfectly distinct."

This remark draws attention to the evident imperfect condition of most of the specimens described and figured, which is very

unfortunate for any palæontologist who may in future have occasion to consult the paper or to identify kindred forms.

The paper will constitute No. 4 of Vol. IV of the Transactions of the St. Louis Academy of Sciences. Much careful study is exhibited in the details of the paper, and it is only to be regretted that the material at hand was of such imperfect nature.

The author regards the genus Inocaulis as a diprionidian graptolite, having found the axis central in specimens of *I. plumulosus*, this indicating a cellular system on both sides the stipe, although there is no distinct evidence of the lateral cells.

The genus Cyclograptus is established for a single discoid species with radiating stipes having central solid axes. This form is particularly interesting from its resemblance to the types of the Quebec group.

A large Conularia is described under the name *C. magnifica*, similar to but much larger than *C. niagarensis*. The specimen, if perfect, would be twenty-four centimeters long.

The author informs us that "the long buried treasures of the former geological survey of the State" (Missouri) have been unearthed.

It would be of value to science if some future Bulletin of the Museum would publish a list of the species contained in the museum which served as types for the numerous species described by Messrs. Shumard, Swallow, Norwood and others from the State of Missouri.—*H. S. Williams.*

GEOLOGICAL NOTES.—*Cambrian.*—Dr. Lehmann, whose quarto volume on the crystalline schists of Saxony is an important contribution to European geology, has abandoned the "Archæan" theory of the origin of these rocks. Below the Post-tertiary deposits of Saxony lies a central elliptic core of granulite rock, around which are grouped zones of various schistose rocks, passing outwards into the normal clay-slates of that part of Germany. On their south-eastern margin these rocks are unconformably overlaid by Silurian and Carboniferous rocks, but on the northwest a conformable sequence is traceable from the schists and slates upwards into Cambrian and Lower Silurian rocks precisely like those of the adjacent countries. Dr. Lehmann has come to the conclusion that the whole of the crystalline schists within the granulite area are metamorphosed Palæozoic sediments, originally of Cambrian or Silurian age. Their metamorphism probably took place during the crumpling and upheaval of the area, which took place later than the Devonian and older than the Carboniferous period. In the progressive intensity of metamorphism the most prominent fact is the corresponding advance in the development of mica. At the same time the muscovite, which alone is present in the outer parts of the area, is replaced further inwards by biotite. Where the crumpling is greatest most biotite occurs.

Dr. Lehmann believes that gabbro is an eruptive rock, younger than the granulite but older than the granite. It has been involved in the general metamorphism, and so has assumed schistose modifications. The Geological Survey of Scotland has recently arrived, independently, at similar conclusions with regard to the diorites and amphibolites of Aberdeen and Banff. The problem in Europe is linked with that presented by similar rocks in this country.

Devonian.—Dr. J. S. Newberry not long ago described the new placoderm genus Myzostoma, with two species, *variabilis* and *terreli* (Trans. N. Y. Acad. Sci. 1883). The teeth consist of strong and massive tables of bony tissue resembling enamel above, and disposed in pairs in both jaws. Those of the lower jaw are three to six inches long, and more than an inch wide. They resemble the teeth of Ceratodus. Only the teeth are yet known.

Carboniferous.—F. Roemer (Zeit. der Deutschen geol. Gesell.) describes *Belinurus silesiacus* from the coal measures of Upper Silesia. The cephalic shield is broad and strongly curved, terminating laterally in two horns, and the abdominal shield is short.

Cretaceous.—Dr. G. Schweinfurth (Zeit. der Deut. geol. Gesell.) contributes a geological map of the strata of the Mokattam mountains, near Cairo, showing the nummulitic Cretaceous strata, the Eocene strata with few nummulites, and the Pliocene red sandstone, rich in pholades.——W. Dames (Zeit. der. Deut. geol. Gesell.) contributes a monograph of the genus Ancistrodon. The teeth called by this name are pharyngeal teeth. As the genus is only found in marine beds, it can scarcely be cyprinoid, and among known pharyngeal teeth belonging to marine teleosteans, the only one resembling Ancistrodon are those of Balistes. But Plectognaths seldom occur in the older formations, whereas Ancistrodon is found in two formations and in both hemispheres. No well-grounded conjecture as to the exact relationships of these teeth can be made. Five species are enumerated, viz., *A. mosensis*, *libyanus*, *texanus*, *armatus* and *vicentinus*, all except the fourth of which are new. The first three are from the Cretaceous of Maestricht, the Lybian desert and Texas respectively. *A. armatus* is from the Eocene of France and Egypt, and *A. vicentinus* from the Oligocene of Upper Italy.——The coals and lignites of the Canadian Northwest are, according to Dr. G. M. Dawson, all of Cretaceous or Tertiary age. The only region yet examined in detail by the Geological Survey of Canada is the extensive one near the Bow and Belly rivers, from the base of the mountains to about the 111th meridian. Anthracite occurs where the Cretaceous rocks have been much disturbed and folded, but on the plains, away from the mountains, the coal assumes more or less the character of lignites.——The thesis presented

by M. de Lacvivier on his admission as doctor of the faculty of sciences, upon the Cretaceous beds of l'Ariège, is the result of many years of labor. The strata below the Cretaceous are not neglected. The writer describes new and interesting Devonian beds which he has discovered, chiefly marbles with remains of Goniatites. The Carboniferous is absent in the department, but the Trias and Jurassic are present, and to the latter must be referred a mass of dolomites and marbles which were previously believed to be Palæozoic, but which contain Jurassic fossils. The uneven surface of the Jurassic beds is filled by a ferruginous deposit (bauxite) forming the base of the Urgonian, which is succeeded by the Gault. Many new fossils are described from the Urgonian, and the Gault is highly fossiliferous. The Upper Cretaceous (Cenomanian, Turonian, Senonian) is completely uncomformable with the Lower.——Some pieces of pumice, thought to have come from Krakatoa, have been picked up at Mayotte, off the north-west coast of Madagascar.

Tertiary.—M. E. van den Brock has discovered fragments of Scandinavian rocks in the Post-tertiary deposits of Belgium. The only known piece large enough to be called an erratic block is of granite, measures $0.8 \times 0.5 + 0.6$ meters, and is imbedded in the fine Campinian sands of Wortel.

General.—A hundred and twenty pages of the Annales des Mines (1884, 2e livraison) are occupied by a study of the stratigraphical geology of the Hartz mountains, with especial reference to the plutonic rocks, diabases, porphyries, gabbros, granites, and to their enclosed metalliferous veins.——F. Kollbeck contributes to the Zeit. der Deut. geol. Gesell. an account of the extensive porphyritic rocks of Southern China.——Messrs. Steenstrup and Lorenzen (Zeit. der Deut. geol. Gesell., 1883) after a study of the so-called meteoric masses of iron in Greenland, conclude that these masses are telluric, and that the presence of nickel can no more be considered as an infallible evidence of meteoric origin.

MINERALOGY.[1]

New Minerals.—*Rinkite*[2] (Lorenzen).—Joh. Lorenzen, of Copenhagen, has given this name to a new mineral from Kangerdluarsuk in Greenland, in honor of Dr. Rink, recently director of the Danish Explorations in Greenland.

It occurs in crystals with arfvedsonite, ægirite, eudialite, steenstrupite, lithia mica, etc.

Monoclinic. Color golden-brown. Translucent in thin splinters, when unaltered; straw-yellow and earthy when altered. Hardness 5. Specific gravity 3.46.

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Phila.

[2] *Zeitsch. für Kryst.*, 1864, IX, p. 248.

A mean of five closely accordant analyses gave:

Fl	SiO_2	TiO_2	CeO	LaO	DiO	YO	FeO	CaO	Na_2O	
5.82	29.08	13.36		21.25		0.92	0.44	23.26	8.98	= 103.11

The formula as deduced is:

$$2\,\overset{II}{R}\,\overset{IV}{R}\,O_3 + NaFl$$

wherein $\overset{II}{R}$ = Ce La Di Y Fe Ca

and $\overset{IV}{R}$ = Si Ti

Before the blowpipe it is fusible with difficulty to a black cinder. It dissolves in borax in the oxidizing flame to a bead which is deep yellow when hot, pale yellow when cold. In the reducing flame it becomes colorless when cold. In salt of phosphorus it shows a skeleton of silica, and gives the same reaction when hot as with borax; when cold, after heating in the reducing flame, it becomes violet. Supersaturation of the bead makes it opaque white. These reactions are due to titanium and cerium. It is decomposed by weak acids, with separation of silica and titanic acid.

The crystals exhibit in polarized light a twinning structure parallel to the orthopinacoid. This structure is also shown by the occurrence of fine striations on the orthodomes and prism.

Polylithionite[1] (Lorenzen).—At the same locality a lithia mica occurs in handsome pale green or white six-sided tables imbedded in albite. These tables are divided into sectors by fine lines or striations resembling those of zinnwaldite (lepidolite). The plane of the optic axes is at right angles to the striations, and shows the crystals to be composed of three or six individuals. The angle between the bisectrix and the vertical to the base is somewhat greater than that given for zinnwaldite, although practically their optical properties are identical. The other characters of the two micas are very similar.

Chemically the mica from Greenland has a larger percentage of fluorine and of lithia and less alumina than most lepidolite.

A mean of three analyses gave:

Fl	SiO	AlO	FeO	K_2O	Na_2O	Li_2O
7.32	59.25	12.07	0.93	5.37	7.63	9.04

The name polylithionite refers to its large per centage of lithia. The mineral, however, is not sufficiently distinct from lepidolite to warrant giving it a specific name, and should be regarded merely as a variety of that mica.

Goyazite[2] (Damour).—In the diamond-bearing sands of Minas Geraes, Brazil, certain rounded, transparent grains of a pale yel-

[1] *Zeitsch. für Kryst.*, 1864, IX, p. 251.
[2] Bull. Soc. Min. de France, 1884, VII, No. 6, p. 204.

low mineral occur which Damour has shown to belong to a new species. The grains have an easy cleavage, and in the polariscope exhibit a cross and series of rings, such as would be given by a section of a uniaxial mineral. The hardness is that of apatite, the specific gravity 3.26.

Heated in a matrass it gives off water and becomes white and opaque. Thin splinters can be fused in the blowpipe flame. Moistened with nitrate of cobalt, a blue color is obtained. It is not attacked by acids.

Composition:

P_2O_5	Al_2O_3	CaO	H_2O	
14.87	50.66	17.33	16.67	= 99.53

The formula P_2O_5 5 Al_2O_3 3 CaO + 9 H_2O is deduced.

The name is taken from that of the province containing the principal diamond localities.

Hillangsite[1] (Igelström).—Igelström has found what he believes to be a new mineral in large quantities at the iron mine of Hillang, in the parish of Ludvika, Sweden. It occurs with garnet, magnetite and igelströmite. It resembles the anthophyllite of Texas, Pa., and the kupfferite of Delaware county, Pa., as also foliated rhodonite; but it is colorless and transparent. Sometimes the mineral is impregnated with microscopic crystals of magnetite, when it becomes black. It has a characteristic nacreous or silky luster, and is white when pure. Hardness = 6. It fuses with difficulty to a slightly magnetic scoria, gives reactions for manganese, and is not dissolved by acids.

As seen by the following analysis it is essentially a bisilicate of the protoxides of iron and manganese:

SiO_2	FeO	MnO	MgO	CaO	
48.25	28.17	12.08	5.86	3.22	= 97.58

According to Bertrand the optical properties are those of the amphiboles. The two cleavages make an angle like that of amphibole, the form is monoclinic and the orientation of the axes is like that in the amphiboles. The composition is also clearly that of an amphibole. Similar species have already been described under the names of silfbergite, dannemorite, asbeferrite. This mineral differs so slightly from these varieties of hornblende that a new name does not seem to be necessary.

Photography as applied to Minerals.—An excellent illustration of the good results that may be obtained from photographs of minerals may be seen in the last number of the Transactions of the Academy of Science of St. Louis.[2] Mr. A. V. Leonhard has illustrated a paper on the occurrence of millerite in St. Louis with some photographs of that mineral reproduced by

[1] Bull. Soc. Min. de France, 1884, VII, No. 6, p. 232.
[2] Vol. IV, No. 3, p. 493, 1884.

the artotype process, and it is at once seen how far superior such views are to any drawings. The mineral itself seems before one. In one picture a calcite crystal is pierced by a spear of millerite. In another a beautiful radiating tuft of needle-like crystals of millerite fill a cavity in the limestone. Four pictures in all are given, these being by far the most valuable part of the paper.

While an outline drawing is undoubtedly necessary for the representation of the precise crystalline form of any mineral, such a drawing, always to some extent conventionalized, may give no idea at all of the natural appearance of the mineral. For purposes of determination, and especially for illustrating fine specimens, it is probable that photography will, before long, be made use of. A complete set of photographs of typical specimens would be highly valued by mineralogists.

Szaboite.—In 1878 Professor A. Koch published a description of a Transylvania mineral which, occurring in minute, thin, tabular crystals in cavities in andesite, he named *szaboite*, in honor of Professor J. Szabó, of Budapest. The mineral was described as triclinic, and as related in composition to babingtonite.

J. A. Krenner, of Budapest, has recently published an extended article[1] on szaboite, in which he comes to the conclusion that szaboite is not a distinct species, but merely a variety of *hypersthene*. A careful optical examination showed identical properties with hypersthene. Crystallographically he found it to be orthorhombic, not triclinic. The cleavage, the plane of the optic axes and bissectrix, the axial dispersion and the pleochroism are all identical with those of hypersthene. The hardness and specific gravity are also similar. Chemically it appears that Professor Koch was both mistaken as to the state of oxidation of the iron, the iron existing as protoxide, not sesquioxide, as he thought, and also that his analysis failed to give the full percentage of magnesia.

Since the proportions of iron and magnesia are variable in hypersthene, and may replace one another, it is held that the only question is as to the precise variety of hypersthene to which szaboite belongs.

Mineralogical Notes.—A Text-book of Descriptive Mineralogy, by Hilary Bauermann, of the Royal School of Mines (London), has just been issued as a companion volume to his Text-book of Systematic Mineralogy, already noticed in the Naturalist. The present volume is a concise presentation of the characters of all the principal minerals, and will be valuable to the class for which it is intended.——An amateur mineralogical journal, published monthly "in the interest of mineralogists and collectors of antiquities of all kinds," and entitled *The Young Mineralogist and Antiquarian*, has reached its second number. The edi-

[1] *Zeitsch. für Kryst.*, IX Band, 3 Heft, 254.

tor, Mr. T. H. Wise, of Wheaton, Ills., is a boy seventeen years of age. The journal is very creditable, and will doubtless be useful to young collectors.——A. V. Leonhard has published in the Transactions of the St. Louis Acad. Science a descriptive catalogue of the minerals of Missouri and a list of the more important localities of minerals in that state.——Dieulafait has examined the so-called "*cipolin marbles*," which occur in lenticular beds in gneiss in various parts of the world. He finds that a trace of manganese is invariably present, and argues from chemical reasons that these marbles and the surrounding gneiss are contemporaneous deposits. Geological investigations have led to the same conclusion.——*Amalgam* has been found at the Friedrichssegen mine near Oberlahnstein. Specimens of native silver and native copper from the same locality have been found by Sandberger to contain traces of mercury.

BOTANY.[1]

Self-planting of Seeds of Porcupine Grass.—In connection with the two notes relating to the fruit of the porcupine grass, it may not be without interest to state that while engaged in geological work in Dakota, north of the Northern Pacific R. R., we were much annoyed by the fruit of this grass. Indeed I found the only way to walk with comfort through this grass was to roll my pants above my knees and my socks down over my shoes.

I also observed, on several occasions, these seeds planted two inches deep in the soil with the awn protruding from the ground. It is plain that with the point of one of these fruits once entered below the surface of the soil the swelling and shrinking, due to varying amounts of moisture, would work the seed directly into the ground.—*F. H. King, River Falls, Wis.*

The adventitious Inflorescence of Cuscuta glomerata.—The flowers of this dodder are in dense clusters, which at maturity are so much crowded that it is impossible to make out their mode of origin, hence they have been described as cymose, panicled or as densely clustered, with no hint or suggestion as to their adventitious origin. A study of their development the past season shows them to be strictly adventitious and, as a consequence, endogenous as to origin.

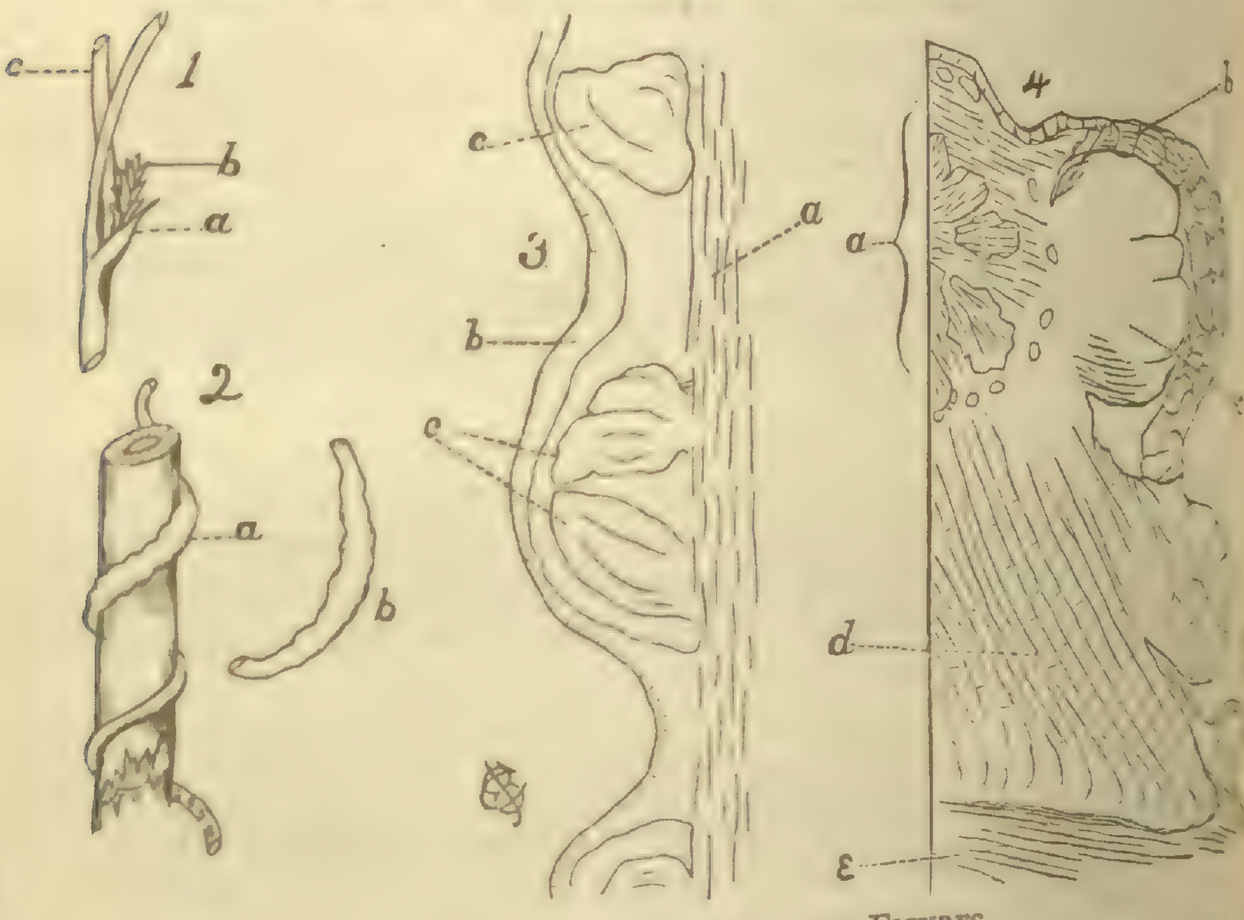
A short time before the flower clusters appear the dodder stems, which are in close contact with their hosts, begin to broaden, as shown in Fig. 2, eventually becoming slightly lobulated. If at this time a longitudinal section of the stem be made, the cause of the broadening will be found to be in the development of numerous adventitious buds from the lateral fibro-vascular bundles. The appearance of these is shown in the outline sketch, Fig. 3, which is reduced from a camera sketch. In a cross-section of the stem

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

essentially the same condition is shown at this time (Fig. 4). In both figures the epidermis and the sub-epidermal or cortical tissues are shown to be pushed out by the developing buds.

As the buds increase in size the epidermal and cortical covering is pushed out more and more until at last it is ruptured somewhat regularly along each side, and the free portions then fall and crowded back by the mass of buds. Fragments of the covering may be seen on the top and sides of the stem in a fully developed cluster of flowers, by careful dissection.

Here and there on the stem may be found, at about the beginning of the development of the adventitious buds, small and rudimentary buds which evidently represent the normal flowering branches (Fig. 1 *b*). These grow from the axils of bracts, and



EXPLANATION OF THE FIGURES.

FIG. 1.—Portion of a stem of *Cuscuta glomerata*, natural size, bearing a bract, from whose axil there grows an abortive flowering branch, *b*, as well as an adventitious branch, *c*.

FIG. 2.—A fragment of a sunflower stem, with a dodder encircling it, the latter enlarged at *a* (shown separately at *b*) by the formation of adventitious buds (natural size).

FIG. 3.—Outline sketch of a small portion of a longitudinal section of *b*, Fig. 2, showing at *a* the fibro-vascular bundle of the dodder stem; *b*, the epidermis and cortical tissues which have been pushed out by the adventitious buds (magnified).

FIG. 4.—Outline sketch of half of a cross-section of the above, more highly magnified; *a*, the fibro-vascular cylinder of the stem; *b*, epidermis and cortical tissues pushed out by the adventitious bud, *c*; *d*, section of a sucker; *e*, tissue of sunflower stem; *f*, hairs of sunflower stem.

while I have not been able to make out the parts of the flower there can be little doubt, from their position and general struc

ture, that they really are rudimentary flowers or flower-clusters, homologous with those of many other dodders as well as those of the morning glories.—*C. E. Bessey.*

Botany in the A. A. A. S.—The botanical papers read during the recent meeting of the American Association for the Advancement of Science, in Philadelphia, were as follows:

The affinities of Dionæa. By Joseph F. James.

A botanical study of the mite gall on the petiole of *Juglans nigra*. By Lillie J. Martin.

The torsion of leaves. By W. J. Beal.

The fossil flora of the globe, three papers. By Lester F. Ward.

Polarity of the leaves of *Erigeron canadense*. By W. J. Beal.

Utricularia vulgaris, with young teleostean fishes entrapped in the bladder-traps of that plant. By H. N. Moseley.

The influence of cross-fertilization upon the development of the strawberry. By Wm. R. Lazeuby.

Stomates on seeds. By Geo. Macloskie.

The adventitious inflorescence of *Cuscuta glomerata*. By C. E. Bessey.

Demonstrations of perforations in the cellular-walls of plant cells. By Louis Elsberg.

The last named paper was, by a curious ruling of the standing committee, assigned not to the section of biology where the botanists were, but to the section of microscopy where the botanists as a rule *were not.*

In addition to the foregoing there were many papers and notes presented to the Botanical Club of the association. The meetings and excursions of the club were most enjoyable and profitable, and many of the plant-lovers of the country had in these the opportunity of making the personal acquaintance of long known but not previously seen correspondents. The joint meeting of the Botanical Club and the Botanical Section of the Philadelphia Academy of Natural Sciences on the evening of September 8th was fully attended. Dr. Asa Gray presided during the formal part of the meeting, in which short addresses were made by many of the principal botanists in attendance.

The Botanical Club was a noticeable feature of the association, and the perfection and compactness of its organization called forth much favorable comment.

New Species of North American Fungi.—*Exobasidium symploci.*— Receptacle lemon-yellow, subglobose and sublobate, 3–3½^{mm} in diameter; conidia hyaline cylindric, nearly straight, 15–21 × 2μ. In distorted flower buds of *Symplocos tinctoria*. Cove Springs, Fla., March, 1884.

Dermatea sabalidis.—Thin, cup-shaped, clustered or scattered, tobacco-brown, 350-450μ in diam. Asci subsessile, 35 × 5μ; sporidia 2-3 seriate, oblong or clavate-oblong, yellowish, 2-nucleate, 4-6 × 1-1¼μ. On dead petioles of *Sabal serrulata*. Cove Springs, Fla., January, 1884.

Asterina subcyanea.— Perithecia hypophyllous, superficial, depressed convex, 250-350μ in diam., of cellular structure, the cells subspherical, 5-7μ in diam., of a deep greenish-blue, connected in a moniliform manner and extending out from the base of the perithecium on all sides so as to form a thin membranaceous border closely appressed to the surface of the leaf; ostiolum papilliform, collapsing when dry and with a broad circular opening; asci slightly narrowed at each end, sessile, 75 × 15μ; sporidia biseriate, oblong-clavate, uniseptate, hyaline, 20 × 5-7μ. On living leaves of *Quercus laurifolia.* Cove Springs, Fla., March, 1884.

Asterina discoidea.—Perithecia hypophyllous, orbicular, slightly depressed in the center, olivaceous, thin, ½-¾^{mm} across, with an indistinct reticulated margin; asci obovate or globose, 30-40 × 30-35μ; sporidia crowded, clavate-oblong or pyriform, uniseptate, 12-16 × 4-5μ. Much resembles *Asterina intricata* E. & M., but color different, asci of a different shape and sporidia larger. On living leaves of *Quercus laurifolia.* Cove Springs, Fla., March, 1884.

Asterina lepidigena.—Perithecia black, subglobose, at length applanate, very thin and fragile, 200-300μ in diam., seated on a hyaline scanty mycelium; asci ovate, 8-spored, 30 × 15μ, or longer and narrower, 42 × 12μ; sporidia obovate, hyaline, biseptate, about 12 × 4μ. Attached to the epidermal scales on living leaves of *Andromeda ferruginea.* Cove Springs, Fla., March, 1884.

Asterina pustulata.—Perithecia imperfectly developed, flattened, 200-500μ across, consisting of a central nucleus of loosely compacted, subglobose, brown cells which, around the circumference, pass into a fringe of closely packed brown, branching hyphæ and forming altogether a circular membranaceous disk (½-¾^{mm}) on the surface of the leaf; asci subglobose, 8-spored, 55μ in diam.; sporidia obovate, hyaline, uniseptate, 30-40 × 10-12μ. On leaves of *Quercus laurifolia.* Cove Springs, Fla., March, 1884.

Ascomycetella floridana.—Hypophyllous; perithecium wanting; asci compacted in yellowish-white specks 500-600μ in diameter, with a subradiate-floccose margin; asci obovate, 75 × 18μ; sporidia clavate-cylindric, multiseptate, 40-45 × 6-7μ. On leaves of *Quercus laurifolia.* The fungus first appears as a mere white floccose speck, barely visible to the naked eye, but soon increasing in diameter and becoming more compact and of a pale cream color. This is evidently referable to Professor Peck's genus Ascomycetella, but is quite distinct from his *A. quercina.* Cove Springs, Fla., winter of 1884.—*J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Botanical Notes.—Experiments lately made by Dr. Stalker, the State veterinarian of Iowa, prove that *Crotalaria sagittalis*, the Rattle-box, is a "loco-plant." In the Missouri valley it is

greedily eaten by horses, and produces great nervous and muscular disorder, in most cases resulting in death.——J. C. Arthur's Contributions to the flora of Iowa, VI, in the Proc. Davenport Acad. Nat. Sci., Vol. IV, adds twenty-four phanerogams to the previous lists, and now for the first time enumerates the pteridophytes, thirty-four in number. Of the latter twenty-three are ferns.——The Journal of the Linnean Society for August contains a curious plate representing pollen cells and an anther of a poppy (*Papaver rhœas*) from a funeral garland from the coffin of an Egyptian princess of the twenty-first dynasty, that is about 1000 B.C. Both pollen-cells and anthers appear to be slightly larger than those of recent plants, but otherwise the resemblance is very close.——H. N. Patterson, of Oquawka, Ill., has issued a neat Check-list of North American Gamopetalæ made to agree with Gray's Synoptical Flora. It will be a convenience in the herbarium.——J. C. Arthur has observed a distinct polarity in the leaves of garden lettuce, according to a note in the *Botanical Gazette*.——Dr. F. Hauck's *Meeresalgen*, being the second volume of the new edition of Rabenhorst's Kryptogamen Flora, has reached part VIII, which contains the Phæozoösporeæ, Oösporeæ and Chlorozoösporeæ.——Luerssen's *Farnpflanzen* (Vol. III of Rabenhorst) has reached part III, devoted to a continuation of the Polypodiaceæ. The illustrations in both the foregoing are most excellent.

ENTOMOLOGY.

Mode of Oviposition of the common longicorn pine borer (*Monohammus confusor*).—The exact mode of deposition of their eggs by the longicorn beetles is not well known, so far as we are aware. We have been fortunate enough to observe the female beetle while at work making the incision with her jaws, though we have not observed the act itself of deposition of the eggs. While examining the fir trees on the western shores of Birch island, Casco bay, Maine, on a warm sunny afternoon of August 30th, I saw a male *Monohammus confusor* standing on the bark of a living fir about nine inches in diameter, within the distance of less than two inches from a female, whose jaws were buried in the bark of the tree on the western side of the trunk which was exposed to the full rays of the sun.

On beginning to make the incision each of the large sharp strong jaws of this beetle are pushed directly into the bark; they are then apparently brought together, and the result is a slight curvilinear gash which descends obliquely in the bark. It is probable that the beetle pries up the pad thus formed, so that the freshly cut edges are exposed, and an opening is thus formed into which the egg is thrust. While watching the female at work the male dropped to the ground, and his consort, becoming alarmed, withdrew her jaws from the incomplete incision, when I seized

her. To the end of her abdomen were attached a few fragments of the reddish inner bark of the fir, and two or three small green pellets, probably excrement; but this showed that she had already deposited at least one egg, and that the labor of oviposition was slight, the end of the abdomen probably being simply extended and thrust into the gape of the incision.

By prying up the pad formed by the jaws, a shallow but roomy cell or chamber is made for the egg, which lies nearly or quite horizontally, not vertically, to the trunk of the tree.

The egg is very large, ovo-cylindrical, well rounded but tapering somewhat at each end, of a dirty white color, and in length is $4\frac{1}{2}^{mm.}$

On visiting the tree a week later and removing a portion of the bark and examining it Sept. 6–8, the eggs had in some cases hatched and the larvæ had begun to descend slightly into the bark. On hatching they begin at once to gnaw a mine, throwing their castings out through the gash originally made by the female, so that it was easy to ascertain, without disturbing the bark, whether the eggs had hatched or not. The larva indifferently lies with either side, dorsal or ventral, presented outwards. Three days after (Sept. 12) several had bored through the pieces of bark making the usual flattened oval hole, but probably in nature the larva remains hidden in the bark through the winter, not beginning to penetrate the wood until the following spring.

The length of the larva when freshly hatched was $5–6^{mm.}$ and the body was rather stouter than in the full-grown larva.

How many eggs are laid by the female is not known, but probably, judging by their large size, comparatively few.

Another female was found on the same tree. Over a hundred gashes had been made on the western side of this fir tree over a space four feet long. The gashes were so fresh that they must have been made on that and a few previous days. They were quite conspicuous and could, after one had become familiar with their appearance, be detected at the distance of at least five or six feet from the tree. I suspect that the sexes couple frequently during the operation of egg laying, as the male was standing so near his mate with his antennæ outstretched and intently watching the female while at work. The males are also probably polygamous.

The industry of the females is well shown by the number of the gashes made, some of which did not however contain any eggs. In the space of a square inch there were three gashes, while in the region where they were thickest, forty were counted in half a square foot. Of course when they hatch all do not live to pass through their transformations. Whether the woodpecker seeks for and discovers the larvæ while encased in the bark is doubtful, and yet it would be easy for these or other birds to pick the grub out of their hiding places. So far as my observations have

gone, the holes made by the woodpecker in forest trees are for the purpose of getting at the inner bark rather than for insects. But a careful examination in September of woodpeckers shot in coniferous forests would throw light on this subject.

In regions where the white pine grows, it is infested by this Monohammus. The spruce is also often infested, but I have not seen clear cases where either of those trees have been killed outright by this destructive borer. But during the past summer I have seen on the islands in Casco bay, and taken out the full-grown larvæ from at least six or seven living firs, which must have been killed by the attacks of this borer, which has been the evident cause of the death of many firs in Maine. I have also been told by lumbermen that fir trees are killed by this borer. Near Rangely, Maine, an extensive tract of firs was killed outright, I was informed, by "the borer," undoubtedly this beetle.

I have seen hundreds, perhaps nearly a thousand, dead firs whose trunks were riddled with the holes of these borers. The spruce is less frequently killed, but I have taken from a dead tree two pieces of spruce bark, each about six inches square, one containing sixteen and the other eighteen holes, through which the beetle had escaped.—*A. S. Packard.*

Egg-laying Habits of the Maple-tree Borer.—Fresh from the foregoing observations I looked, Sept. 12th, for the eggs or freshly hatched larvæ of *Glycobius speciosus*, and found the latter at once. The Rev. Mr. Leonard, of Dublin, N. H., many years ago, in a letter to Dr. Harris, stated that the maple-tree borer, on hatching, remained in the bark through the winter. Upon examining a rock maple about two feet in diameter, it was found that twenty eggs had been laid in different parts of the bark from near the ground to where the branches originated, a distance of about ten feet. The site of oviposition was recognized by a rusty irregular discoloration of the bark about the size of a cent, and especially by the "frass" or castings which to the length of an inch or more were attached like a broken corkscrew to the bark. On cutting into the bark the recently hatched larvæ 5–7 ^{mm} in length, were found lying in their mine or burrow at the depth of from a tenth to the sixth of an inch.

The burrows already made were about an inch long, some a little longer; the larva usually mines upward. No eggs were found, but they are laid in obscurely marked gashes about a fifth of an inch long, usually near a crevice in the bark. These gashes and castings are readily discoverable, and it would be easy to save these valuable shade trees by looking for them in the autumn and winter or early spring, and cutting them out. The beetles were not uncommon at Brunswick in July and August of the past year.

Of six grubs which I cut out one half seemed unhealthy, perhaps diseased by the water which had penetrated their mine.

I have recommended protecting valuable shade trees by wrapping the trunks with bands of cloth well saturated with kerosene oil, in August and September, so as to drive off the beetle, and to destroy the freshly hatched grub, but since discovering how easily the gashes and castings of the freshly hatched worms can be detected a few days or weeks after the eggs have been laid, it seems obvious that the easiest and surest preventive is to cut out the grubs when laying in their autumn and winter quarters just under the surface of the bark.

It is almost impossible to destroy the fully grown worms in their "mines" or burrows, since the latter extend up the tree either directly under the bark or sunken in the wood. On one tree, nearly destroyed by this borer, out of about fourteen mines, twelve extended upward. Hence it is useless to try to find the hole and inject oil into it. There now seems no reason why valuable shade maple trees should not be saved by an hour's close observation and removal of the young grubs, say in September or October.—*A. S. Packard.*

PALMEN'S PAIRED OUTLETS OF THE SEXUAL ORGANS OF INSECTS.[1]—In an investigation of this kind it is natural that the anatomist should seek the most primitive condition of almost any organ in insects, in that primitive generalized group, the Pseudoneuroptera and especially the Ephemerina. The double nature of the oviducts and male outlets in this group had been slightly indicated by Swammerdam and Burmeister, but Palmén in this elaborate and learned essay has thrown much new light on the subject and reaches some most interesting conclusions. The work is divided into five chapters, the first being introductory and being a history of entomotomy. In the second chapter the opinions of the earlier authors on the sexual organs of the Ephemerina are given, and in the third chapter the author's own very complete observations are recorded, while in the fifth chapter the ovaries and oviducts of other insects, principally certain Pseudoneuroptera, Orthoptera and Neuroptera, are described. The drawings and microscopic sections are well rendered, and on plate v are given useful diagrammatic figures illustrating the morphology of the ovaries and oviducts of selected types of the lower orders of insects as compared with the ovaries and segmental organs of the worms and Crustacea.

Professor Palmén's conclusions, drawn from his studies on the Ephemeridæ, are as follows:

1. The genital ducts are in both sexes throughout their whole extent independent of each other and also paired. Their terminal sections become united only by the integument itself under

[1] Ueber paarige Ausführungsgänge der Geschlechtorgane bei Insecten. Eine morphologische untersuchung. V on J. A. Palmén. Mit 5 tafeln. Helsingsfors, 1884. 8vo, pp. 108.

them; in the males the two ducts open out in the partly formed outgrowths of the integument forming the two penes; in the females they are united by means of a transverse ingrowth of the integument, the genital intersegmental fold.

2. The entire apparatus consists also of two heterogeneous components: internal parts which are developed from the genital germs of the embryo, and are simply cellular, and external, tegumental parts (the chitinous cuticula) which slough off during growth.

These two components arise from two different sources: the internal are differentiations of the embryonic epithelium of the body cavity; the external, like the integument generally, originate directly from the epiblast of the embryo.

3. In the terminal section of the passages leading outward (ductus ejaculatorius and the oviduct) no chitinous cuticula has been observed.

4. The male ducts open behind the ninth, the female behind the seventh abdominal segment.

5. In the passages leading out, the principle of division of labor is only partially carried out. Accordingly the corresponding sections of the ducts differ little from each other morphologically, and differentiations in the shape of peculiar forms of appendages are, as a rule, not present.

As regards the fourth point the Ephemerina differ from other insects (in which it opens behind the eighth) in having the oviduct open behind the seventh abdominal segment. This indicates, Palmén thinks, a high phyletic age for this group.

Graber's statement that the sexual passages in the pupa of Chironomus are paired, is referred to, and Palmén adds that this is the case with Corethra and other dipterous pupæ. Finally it appears that anatomical and embryological modes of investigation have brought about similar results.

THE NATURE OF THE SO-CALLED "LIVER" IN THE ARACHNIDS.—We have received from Dr. Bertkau his final essay on this interesting subject, and translate his conclusions. The original appears in the Archiv für mikroskopischer Anatomie, band 23, 1884.

The "liver" of spiders so develops that the enlarged part of the digestive tract in the base of the abdomen forms a considerable number of smaller and larger outgrowths, which branch out more and more, and through an intermediary tissue becomes united into an anatomical unity.

Among the outgrowths of the digestive tract are five of considerable extent; one is situated in front on the under side of the intestinal tract; the rest are arranged in pairs behind on the upper side; the hindermost pair are at first narrow and have in their walls muscular fibers (?). The outgrowths, like the part of the digestive tract, where they arise are of a glandular nature.

Among the epithelial cells are to be distinguished two kinds, smaller oval cells filled densely with large colorless nuclei, and larger club-shaped ones whose contents, among other things, consist of small crystals and larger drops of yellow, brown, green colors.

The principal effect of the secretion of these glandular cells is the solution and digestion of fibrin, digested protoplasm, etc.

The spiders take no solid nourishment. They dissolve the assimilable, solid constituents of their prey, muscles, etc., and they suck the flowing blood. This passes into the ultimate branches of the intestinal outgrowths. The hind gut or terminal section of the digestive canal begins immediately behind the last pair of the intestinal outgrowths or diverticula.

The malphigian vessels are dispersed through the intermediate tissue. Their excretions are guanin or an allied substance. The same or an allied substance is found in many kinds, both deposited in the external layer of the intermediate tissue and distributed prominently in the coloring and markings of animals.

In the present condition of our knowledge it is fitting to supply the name "liver" in the Arachnida by "chyle-stomach."

We do not feel entirely satisfied with the last main conclusion. The same mode of reasoning might be applied to the vertebrate liver, which is composed of diverticula of the chyle-stomach. There seems to us no good reason for not, as a matter of convenience, applying the term "liver" to the enormous glandular outgrowths of the Arachnidan chyle-stomach. To confound the "liver" of a spider with its source, the chyle-stomach, is not, we would suggest, good morphology. Moreover, embryology shows that the diverticula are secondary outgrowths from the mid-gut of the embryo, which becomes finally the chyle-stomach of the adult animal.—*A. S. P.*

The Systematic Position of the Embiidæ.—It will be remembered that this singular group of insects is usually placed next below the white ants (Termitidæ). Mr. J. Wood-Mason has added to our knowledge of these insects, and concludes as follows regarding their affinities: "In anticipation of the full and detailed account of the numerous and important differences between them and the Perlidæ which is in preparation, and will be published as soon as the drawings needed to render my descriptions intelligible are ready, I may say that the Embiidæ undoubtedly belong to the true Orthoptera, that they are in my opinion in some respects the lowest term, and in others the lowest term but one, of a series formed by the families Acridioidea, Locustidæ, Gryllidæ and Phasmatidæ, and that their resemblances to the much lower Perlidæ, which may well be direct descendants of a form closely related to Campodea, are due to their low position in the division of Orthopterous insects to which they belong, and

do not imply any such close genetic relationship to them as has been suggested" (Proc. Zool. Soc. London, 1884).

Mr. Mason has detected the females, before unknown, which are wingless and of larger size than the males. He also discovered in India larvæ of a species apparently living in society.

Entomological Notes.—A case of sexual attraction in Prionus is noticed by Anna K. Dimmock in *Psyche* for April. A female about to oviposit was caged, when one male after another flew to the cage, so that a great many males were taken in the afternoon. "On account of the presence of so many males a number of females made their appearance, showing an attraction of the female to the male, like that above noted of males attracted by females." Apropos of this fact, Mr. F. Clarkson states in the *Canadian Entomologist* for May, that the presence of *Prionus brevicornis* is quickly realized by the odor of the female, which is very powerful and can readily be detected twenty feet distant. "I placed a female immediately after emergence in an uncovered jar, and wherever I positioned it, on the piazza or elsewhere, the males were attracted from every direction I captured twenty males in a very few minutes."——Mr. W. H. Edwards contributes to the *Canadian Entomologist* for May, useful directions for breeding butterflies from the egg.——M. Jules Künckel has communicated to the Paris Academy of Science, as the result of his researches upon the movements of the heart in insects during their metamorphosis, the statement that this organ continues to beat during the phenomena of histogenesis. In *Volucella zonasia* and *Eristalis æneus* it was observed that when movement was lost, on the twelfth day in the first species and the ninth in the second, the two great wing muscles were already developed, and the eyes were evident upon dissection. The short period of quiescence of the heart is occupied in the histological changes of that organ, above all in the formation of an aortic region corresponding to the formation of the thorax.——The researches of M. Carlet have brought to light a previously unknown part of the sting of the honey-making Hymenoptera. The poison-bag of these insects is destitute of a muscular wall, and is thus incapable of emptying itself, but the stylets of the sting are furnished at their base with a veritable piston which moves within the length of the base of the sting, and whether the stylets move simultaneously or alternately, at each movement forces a drop of venom into the wound and produces a new afflux of liquid at the base of the sting, which is thus at once an aspirator and an injector.

ZOÖLOGY.

New Classification of the Rotifers.—Dr. C. T. Hudson, in the *Quarterly Journal of Microscopical Science* for July, attempts a re-classification of the rotifers. His paper, which is illustrated

with figures of nearly each genus, will prove very useful to American microscopists. After remarking upon and criticizing the systems of Ehrenberg, Dujardin, Leydig and Bartsch, he offers one of his own. The class Rotifera falls, he thinks, into four natural orders, according to their modes of locomotion. "There are some that swim only; others that both swim and creep like a leech; those that both swim and skip; and lastly those that when adult are fixed; and these orders differ in the main from each other in the form and use of the foot. In each order, too, there are typical genera, round which the rest may be grouped, differing from each other in the shape of the trochal disc and the position of its ciliary wreaths, as also in the structure of the manducatory organs, and sometimes in other important points as well."

The form of the mouth-parts affords good family characteristics, while a difference in the shape and disposition of the trochal disc and its ciliary wreaths generally accompanies a difference in the manducatory organs, the two together serving "as good guides to a re-classification of the rotifers into families, which the author attempts to do.

Dr. Hudson's system is as follows:

CLASS ROTIFERA.

Order I. RHIZOTA.—Fixed forms; foot attached, transversely wrinkled, non-retractile, truncate. Family 1. *Flosculariadæ* (Floscularia, Stephanoceros): Fam. 2. *Melicertadæ* (Melicerta, Limnias, Œcistes, Cephalosiphon, Lacinularia, Megalotrocha, Conochilus).

Order II. BDELLOIDA.—That swim and creep like a leech; foot retractile, jointed, telescopic, termination furcate. Fam. 3. Philodinadæ (Philodina, Rotifer, Callidina).

Order III. PLÖIMA.—That only swim. Fam. 4. *Hydatinadæ* (Hydatina, Rhinops); Fam. 5. *Synchætadæ* (Synchæta, Polyarthra); Fam. 6. *Notommatidæ* (Notommata, Diglena, Furcularia, Scaridium, Pleurotrocha, Distemma); Fam. 7. *Triarthradæ* (Triarthra); Fam. 8. *Asplanchnadæ* (Asplanchna); Fam 9. *Brachionidæ* (Brachionus, Noteus, Anuræa, Sacculus); Fam. 10. *Pterodinadæ* (Pterodina, Pompholyx); Fam. 11. *Euchlanidæ* (Euchlanis, Salpina, Diplax, Monostyla, Colurus, Monura, Metopidia, Stephanops, Monocerca, Mastigocerca, Dinocharis).

Order IV. SCIRTOPODA.—That swim with their ciliary wreath, and skip by means of hollow limbs with internal locomotor muscles. Fam. 12. *Pedalionidæ* (Pedalion).

THE NATURE OF ECHINODERMS.—At the Paris Academy of Sciences M. Viguier reviewed the various theories respecting the nature of echinoderms. Some, as Cuvier, the elder and younger Agassiz, and Metchnikoff, considered them as simple radiate animals approaching the acalephs and ctenophores; while others, as Leuckart and Claus, believed that the worms, especially the gephyreans, were their nearest relatives. A third opinion, originated by Duvernoy and sustained by Haeckel, regarded an echinoderm as the result of the union of five vermiform organisms, and lastly M. Perrier considered it as composed of five reproduc-

tive individuals grouped around a nutritive individual. The last theory accounted for facts which could not be explained by that of Haeckel. M. Perrier communicated the details of his researches upon the anatomy of adult Comatulæ. From these researches, based upon more than two hundred sections, it appears that the organization of a Comatula is singularly like that of other echinoderms, notwithstanding the apparent wide divergence. If a sea-urchin is considered as a crinoid, the arms of which have become attached to the surface of the voluminous disk, and the mouth of which is placed at the point of insertion of the disk upon the stem, the nervous and ambulacral systems will have the same relations as in the Comatula. It is worthy of notice that at this spot the calyx of many crinoids is invaginated, and presents points not without analogy with the dental apparatus of the sea-urchins.

Destruction of Dog-fish by an Isopod Crustacean.—From a communication made by Dr. Day to the Zoölogical Society of London (Feb. 5, 1884) it appears that an elongated Isopod (*Cenidera cylindracea*), some of which attain a length of one and a quarter inches, devour the soft parts of the dog-fish, muscles and entrails. On one occasion 100 dog-fish were netted, and "nearly every fish was found to have been eaten in a like manner by the lice." These "lice," as the fishermen call them, "in the summer months are found from fifteen to twenty miles from land, generally on soft and sandy bottoms. When the fishermen in foggy weather get on this bottom, they call it 'lousy ground.' Where the lice are abundant they drive away the congers and other fish. Often a shoal of bream will come and eat them up."

Are the "Chimneys" of burrowing Crayfish designed?—In *Nature*, No. 726 (June 5, 1884), Mr. Ralph S. Tarr gives an interesting account of his observations of the chimney-building crayfish (*Cambarus diogenes*). His conclusions and my own with reference to this crustacean tally except upon one point. Mr. Tarr remarks, "I do not think the chimney is a necessary part of the nest, but simply the result of digging." On the contrary, I am convinced that the crayfish *builds* his chimney or tower; that he often studies the locality with care and *builds* to suit the chosen site. My reasons for this conclusion are: That a large series observed during the present year were so placed on a steeply sloping bank of a ditch, that if the materials of which the towers were composed had been simply rejected matter derived from tunnelling, then it could have been rolled into the ditch without trouble, while in fact an artistic tower, only two inches in diameter and varying from eight to eleven inches in height, was erected; and in several instances the base of the tower was specially provided for by having the ground leveled and smoothed before the foundation masses of *puddled* clay were

put in position. Of a series of forty towers built by the *Cambarus diogenes* that I observed on the banks of a ditch, not one could have been the result of accident, as suggested by Mr. Tarr.

The towers that were found in the meadows, at a considerable distance from open water, were invariably broader at the base, and never so high as those described as found on the edge of flowing water. These open-meadow towers or chimneys, however, were all found to be composed of pellets of clay so arranged as to render it highly improbable that their positions were fortuitous. Indeed, in the majority of instances it would have been practicable to have rolled the little balls of clay to a considerable distance from the opening of the tunnel.

Perhaps there is a bearing on the question of design in tower building in the fact that often half-grown or even smaller crayfish of this species build the most elaborate structures. Some of the finest examples, *i. e.*, the most slender and tallest were the work of diminutive little fellows which certainly could have avoided a deal of labor if the chimneys or towers were not designed.

I have never seen a *Cambarus diogenes* in the act of tower-building, nor been able to determine why they tunneled at all. When this is determined I believe the towers will be found to have a close connection with the purposes of the subterranean haunts of the burrowing crayfish.—*Chas. C. Abbott.*

The Crustacea of the Talisman Expedition.—The *Talisman* brought home a fine collection of Crustacea from all depths. Swimming crabs appear to be rare at great depths, yet species of Bathynectes were found at from 450 to 950 meters off Morocco and the Cape Verde isles. Anomoura were abundant at very great depths and usually belonged to transition forms. Some of these have a very wide distribution, thus *Homola cuvierii*, previously thought to be exclusively Mediterranean, was found at the Azores and Canaries, and a species of Dicranomia described by Milne-Edwards from the Antilles, was found at the Azores. Some Galatheas were taken from the interior of the sponges of the genus Aphrocallistes. *Galathodes antonii* and *Ptychogaster formosus*, a species with its abdomen twice coiled upon itself, were dredged at 4000 meters. A considerable number of genera and species of Eryonidea were taken.

A remarkable new shrimp is *Nematocarcinus gracilipes*, with wonderfully attenuated feet and antennæ. In *Glyphus marsupialis*, another Caridean, the female has the lateral portions of the abdominal segments developed into a sort of pouch for the reception of the eggs.

Races and Hybrids among the Salmonidæ.—Dr. F. Day publishes additional facts on this subject in the Proceedings of the Zoölogical Society of London for 1884, p. 17. His previous observations, published in 1882, tended to show that the number

of species existing in Great Britain had been unduly multiplied by local races or varieties which were considered as species. Dr. Day first describes a hybrid between *Salmo salar* and *S. levenensis*, the Loch Leven trout. Here it may be said that he has raised several parrs "with comparatively large ova, which were of a deep reddish color, thus almost disposing of the statement that 'no parr has ever been found with mature ova' [Gunther's Introduction to the study of Fish, p. 639]. Certainly the ova were not mature, but would have been had the fish not met with an untimely end while the parr-marks were present, and so likewise were the silvery scales of the smolt. And as I shall show, we found at the end of November other females with ova, in all of which the parr-marks were visible."

His observations also "conclusively show that the females, without descending to the sea, may develop eggs in fresh water. And though we know that in the case of rivers in which their access to the sea has been cut off, or their migrating to the ocean prevented from any cause, these fish have usually disappeared from such streams, still we are aware that land-locked salmon are found in various parts of the globe."

On Nov. 15, 1882, 8000 ova were taken from an American charr (*Salmo fontinalis*) which were fertilized with milt from a Loch Leven trout; many of the young were more or less and variously deformed. "It is interesting to observe that about one in six of the eggs of the Loch Leven trout impregnated by the American charr failed to hatch, but double that number, or one in three, of the American charr eggs impregnated from Loch Leven trout-milt. The same reason which appears to militate against trout-eggs being impregnated by salmon-milt probably is the cause, *i. e.*, the size of the spermatozoa. Thus the comparatively large Loch Leven trout-eggs were fertilized from the milt of the charr; but when the converse was tried the success was much less. As the American charr-eggs are much smaller than those of the Loch Leven trout, it is reasonable to suppose the spermatozoa are also smaller, and consequently were readily absorbed; but when it was attempted to fertilize the *Salmo fontinalis* by the milt of *S. levenensis* probably the large spermatazoa did not readily find entrance, thus accounting for the great proportion of unhatched ova. * * * *

"An exceeding interesting subject of investigation is whether we possess several or only one species of river trout. The foregoing descriptions of hybrids show that although neither the salmon nor Loch Leven trout possesses white edges to the dorsal and anal fins (such being usually restricted to the brook trout), hybrids between the two appear invariably to be so marked. This year's investigations at Howietown have likewise shown that such a mode of color may occur in old Loch Leven trout, especially males."

After detailing experiments in raising young from eggs of American charr fertilized by Scotch, Dr. Day finally remarks "Considering that these fishes have shown no tendency to monstrosities, have been well formed, and grown fairly in proportion to the young of the true American charr hatched at the same time, I cannot resist thinking that it may be possible that these two fish, although so widely differing in color, may be merely varieties of one species, descendants from one common stock. This question, however, will be more appropriately discussed when we possess fish a year or two older."

ACCELERATION IN DEER ANTLERS.—Besides the white-tailed deer mentioned in my note in the July, 1884, number of the NATURALIST, I have in my collection the antler of a *Cervus macrotis* found near Carter, on the Rocky mountains, which is *abnormally* flattened, which shows no indication of having been injured, and so tends to support your position. It is doubly bifurcated. For four inches above the burr it is cylindrical and five and a-half inches in circumference. There it throws off a basal snag two inches long. Thence it commences to flatten, and at the first bifurcation, seven inches above the snag, it is six inches broad, whence the upper prong extends seven inches to its fork, where it is four inches wide. Above this the tines are seven inches long, and gradually assume the cylindrical form to their points. This description would answer for the lower branch except that it is not so wide by half an inch.

It is the largest antler I have ever seen from a mule deer, and is the only one I have ever seen showing a tendency to flatten. There is not the least indication of distortion, but it is perfectly symmetrical in all its parts.—*J. D. Caton.*

[*Note by the Editor.*—This case is paralleled by one observed by myself in a store in St. Paul, Minn., during the summer of 1883. This is a black-tailed deer which has one of its horns completely palmated as in Alces, while the other shows much less palmation. As I explained in the July NATURALIST, this is a case of the process of acceleration, which resulted in the creation of the genus Alces.—*E. D. Cope.*]

HABITS OF THE PANTHER.—I was much interested, as I presume many others were also, in the carefully written and, as I believe, generally accurate account of the cougar, or panther (*Felis concolor*), by Mr. Livingston Stone, in one of the recent numbers of the *Forest and Stream*. As any information regarding this rare and formidable animal is usually read with avidity by those at all interested in the fast disappearing denizens of our forests and mountains, I am tempted to add a few items of my own observation upon the habits and characteristics of this great cat, more especially as my experience in one or two minor points differs somewhat from the conclusions of Mr. Stone.

Seldom found very abundantly in any portion of our country, when compared with other wild animals of equal size, and still more rarely killed, unless by poison, the panther is nevertheless usually the first animal which disappears before the advance of civilization. They are extinct in most localities long before the deer or bears have suffered any serious diminution in numbers. Upon many portions of this coast, however, panthers are still frequently met with. It has always been a perplexing matter to my mind why the pioneers, many of whom were well acquainted with the animal as found in the Eastern forests, and knowing it there as the cougar or panther, should have straightway set about calling the same animal which they found here the California or mountain lion. Certainly in appearance the two panthers are so nearly alike that no one would dream, upon comparing them, of regarding them as distinct species.

As to their habits, my ignorance of those of the Eastern animal prevents me from comparing them in that particular. Only upon one point I can speak, and on that so far as my knowledge extends, and also from the assertions of many old hunters and trappers who were perfectly familiar with them. The panther of the West coast never indulges, for his own entertainment, in those fierce, cat-like screams with which his eastern brother occasionally makes the night hideous when hungry or lonely. I have heard their savage yell as far west as the Raton mountains on the Santa Fè trail, but although I have hunted and camped for weeks and months at a time all through the Sierra Nevada coast and Cascade ranges, from Washington Territory and Oregon in the north, to the Mexican line of San Diego in the south, in many parts of which the panthers were so abundant that their fresh tracks could be seen daily, I have always listened in vain there for their characteristic cry.

The more I learned of them in their native haunts the more skeptical I became in regard to their ever willingly attacking a man. I have known them on several occasions to follow persons a short distance, and I have seen wolves do the same thing, especially when I have been packing in freshly-killed meat, but I do not believe that in either case they meditated an attack. In one instance, in the Cascades near the Hood, I knew a panther to jump at a man as he lay at night in his blankets, but as soon as the man partly arose and shouted for assistance, the animal bounded into the brush and disappeared. In talking it over we all came to the conclusion that the panther had seen the man move under his blankets and had mistaken him for some less formidable antagonist, and that when the deception was revealed to him he threw up the job at once. As for those stories we read occasionally about their chasing a man on horseback for several miles, in which the writer assures his readers that he only escaped being devoured by being providentially mounted upon the fastest

horse in all that section of the country, they appear so absurd to to all hunters acquainted with the animal in question, that they are looked upon at once as extracts from "Dashing Dick of the Wild West," in the dime novel series.

That the panther will run from and tree before the smallest yelping cur that can be induced to follow his trail is true, but I am satisfied that instinct in some mysterious manner warns them of the hunter behind the dog, and that it is the latter only which they hold in fear. This I have demonstrated to my own satisfaction, and have had it corroborated by others. Upon one occasion I followed a panther that was being chased by a settler's dog in the dense hemlock and spruce forest through which the Clascanine river, in Oregon, runs, and although the plucky little cur treed him at least a dozen times, I did not succeed in obtaining the slightest glimpse of the brute, and after chasing him from early dawn until late in the afternoon, through the most terrific wilderness of almost impenetrable thickets, immense fallen trees and giant ferns, I found myself so completely used up that I was forced to relinquish the pursuit from sheer fatigue.

In this instance the panther must have paid but little attention to the dog after he treed, but put in the time listening for my approach, and as soon as that was ascertained he would jump at once to the ground, continue his flight for perhaps half a mile or more, when he would again take to a tree and the same thing would be repeated. Two or three times, where the ground was particularly favorable, I got near enough to hear him leave the tree, which he seemed to do just as readily as if there had been no dog there.

In regard to their manner of climbing, they ascend the immense trees near the mouth of the Columbia, which are frequently 300 feet high, and sixty, eighty or even a hundred feet to the first limb, precisely as a cat would climb them, and, when wounded, will sometimes go to the very top. In one instance I found in a small glade in the forest where, from the sign, it was evident that two or more of them had been gamboling, and like kittens scurrying around in the grass, and then bounding against the trunk of a tree at a point at least ten feet from the ground, they had ascended apparently on the run, tearing off great pieces of bark, and leaving claw marks a foot long on each side.

Although they may in some localities spend the day in lying upon the limb of a tree, I think they always prefer rocky ledges and caverns for that purpose, where such are accessible. In San Diego, near the Arizona line, the rugged, rocky ranges furnish admirable retreats for panthers, there usually called mountain lions; and although not so abundant, they are, I think, more frequently shot than they are further north, for reasons that will soon be explained. Like all of the cat tribe they are partial to warmth, and upon days when it is rather cold in the shade, they

frequently come out of their lairs in the middle of the day and lie upon the rocks near by to bask and drowse in the warm sun, and as the ranges there are generally very sparsely timbered, they are occasionally discovered by hunters, when the chances of getting within shot are better than under almost any other circumstances. But for all that, they are animals that are seldom shot, no matter how abundant they may be, and their disappearing so rapidly before the march of civilization is a mystery that I can only solve by the conclusion that being such a large and entirely carnivorous animal, they are immediately affected by the least thinning out of the large game, and are driven by hunger to seek places where the rifle has not begun its deadly work, unless, as they seem to have done on the McCloud river, they turn their attention to the stock of the settler.

Many of them are poisoned by the sheep and cattle men of the southern counties, when their visits to the flocks and herds become too frequent. I have often seen their hides nailed to the walls of the lonely cabins of the stockmen there, and, upon inquiry, have found that they were poisoned in at least three cases out of four.

I entirely agree with Mr. Stone in the belief that a panther would be no match for a grizzly. It is quite possible that their superior agility might sometimes make them more than a match for a black bear, but I can only conceive of their being able to kill a grizzly by fastening upon him in a position where the bear was unable to inflict any injury upon them, as a single, well-directed blow from the paw of a full-grown grizzly will crush in the ribs of an ox, and would, I fancy, leave but little fight in any panther.

With a single incident to illustrate the idea that it is the hunter and not the dog the panther fears, I will close this already lengthy article. In the summer of 1868 I was in Port Gamble, on Puget sound. A trail leading to Port Madison, eight or ten miles distant, was the only land route open in any direction, and that ran through an unbroken forest the entire distance. One of the workmen at the saw-mill at Gamble was returning along the trail from Madison, one afternoon, having with him a favorite little dog, who was trotting along a few yards in advance, when a panther bounded suddenly from the brush and, snatching up the dog, disappeared with the quickness of thought on the other side of the way. The man stated that it was so quickly done that he seemed to take the dog without stopping in a flying leap across the trail.—*Forked Deer, in Forest and Stream.*

Zoological Notes.—*Fishes.*—In Switzerland, according to M. V. Fatio, the minnow reaches an altitude of 2400 meters, and the miller's thumb one of 2200 meters. The perch stops at 2000 meters, and no others pass above 800 meters, although the carp,

tench, rudd, roach and chub have been successfully introduced into waters at from 1000 to 1700 meters in altitude. *Gobius fluviatilis* has ascended the Po to the confines of Switzerland, and *Blennius cognata* occurs in abundance in Lake Maggiore and in the Lake of Bourget in Savoy.

Mammals.—MM. Pouchet and Beauregard have been led by the examination of a portion of the "case" containing the spermaceti of the cachalot, to emit the supposition that the "roots" of this case may be the analogue (homologue?) of the posterior region of the right nasal fossa, while the reservoirs situated anteriorly may represent the smooth part of the same nasal cavity, separated from the spouting sacs or opening into them only by an extremely reduced orifice. The walls of the part of the case examined consisted of mucous membrane fifteen millimeters thick, with the surface raised into convolutions separated by fissures in such a way as to recall the surface of the brain. The secretion is thus non-glandular and approaches, physiologically, the secretion of wax by the bee. The structure of the case of the cachalot does not recall any organ present among mammals.

PHYSIOLOGY.[1]

The Physiology of Rumination. — As is well known, the stomach of a ruminant animal is a complex organ consisting of four distinct chambers. Of these the last, that opening directly into the intestine, corresponds functionally to the single stomach of other vertebrates, the other chambers of the herbivorous stomach probably only being concerned in the preparation of food preliminary to digestion. The feeding of ruminants is characterized by the fact that the food when first swallowed passes only as far as the first and largest division of the stomach, the paunch, where enormous quantities may be laid up. When the animal has ceased feeding it seeks a position of rest and then begins a regurgitation by piecemeal of food from the paunch into the mouth, where it is thoroughly masticated, "chewing the cud," after which it is swallowed into the "fourth stomach" for final digestion. It is this process of rumination which Professor Luchsinger has recently studied in the goat.

Attention is called to the fact that the act of rumination is interrupted if the animal is disturbed in the slightest degree. The goats experimented on were narcotized with morphia, which numbs painful sensations but interferes little with reflex action. After appropriate operations, the author was enabled to assure himself that pressure with the hand upon the wall of the paunch brought about in perfectly normal manner the act of rumination. there was first a movement of the vocal cords tending to close the glottis, then the diaphragm contracted so as to press upon

[1] This department is edited by Professor Henry Sewall, of Ann Arbor, Michigan.

the upper surface of the stomach, and at the same time the abdominal walls contracted energetically; a morsel of food was thus thrown up rapidly into the mouth, any excess of water in it being pressed out and swallowed; then began a long series of cud chewing movements, at the beginning of which occurred a copious flow of saliva into the mouth; finally, with a swallowing movement the mouth was emptied and the masticated morsel sent back for its complete digestion. The amount of food regurgitated was determined by the sphincter muscles at the cardiac opening of the paunch, these muscles relaxing at the beginning of the act but closing finally again when a small amount of food had been forced out. The whole series of movements was readily brought about by electrical stimulation of the wall of the paunch, or when this was mechanically excited by distension with warm water or by pressure with the hand. Strange to say the flow of saliva and the chewing movements followed in regular order expulsion of food from the paunch, though the morsel was not, in some cases allowed to enter the mouth but was expelled lower down from the divided œsophagus. This artificially excited act of rumination could only be provoked when the pneumogastric nerves were intact.

Luchsinger concludes that rumination is a complex reflex action, the stimulus to which is the distension of the walls of the paunch by the accumulated food matter, the amount of pressure upon the wall being also, no doubt, regulated by the motor nerves of the stomach. The afferent nerves concerned in the reflex are probably the vagi, and these call into coördinated action a number of correlated nerve centers governing salivation, mastication and movements of the vocal and swallowing apparatus.—*Pfluger's arch., 1884, Bd. 34, S. 293.*

Circulation of Blood Corpuscles.—Dr. G. J. Hamilton has made an examination of the physical conditions which affect the movement of solid bodies suspended in a circulating fluid with reference to the analogous case of the blood corpuscles in the living body, and his results are full of suggestiveness in the explanation of many obscure phenomena of pathology. The blood corpuscles are solid bodies suspended in a liquid plasma; the red corpuscles outnumber the white about 300 or 400 to one. It was the aim of the author to determine the relation between the specific gravity of the corpuscles (with respect to that of the plasma) and the circulation of the blood. A stream of water was allowed to flow through a horizontal tube several feet in length, and little balls or disks of wax and other substances of various sizes and specific gravities were dropped into the current and carried along by it. In this simple scheme of the circulation it was found that the balls or disks when specifically lighter or heavier than the fluid were carried along the sides of the tube, in the former case

against the upper and in the latter against the lower side. Friction on the tube wall retarded the motion and gave a rotating movement to the solid bodies which tended to accumulate and clog the bore of the tube.

When the balls were of the same specific gravity as water they were swept along the middle of the tube and remained always in the "axial" or swiftest moving central current without touching the sides. In the normal circulation of the frog it can be shown that the white corpuscles pass along the upper wall of the blood vessel with a rotating motion. In order to make this observation the vessel observed must lie in a horizontal position while the web or sheet of tissue holding it is in a vertical plane. When the blood-vessel twists so that what was once the upper side becomes the under, the white corpuscle, carried on by the current, gradually crosses the stream and reaches the new top wall. These facts are easily explained when it is considered that the white corpuscles are specifically lighter than the blood plasma. The red blood corpuscles move in a crowd, without rotation, away from the vessel wall, in the so-called axial current, which is more marked the more rapid the circulation.

The red corpuscles are specifically scarcely heavier than the plasma, while the white are considerably lighter. The author points out the evident conclusion from his experiments, that the relation between the specific gravities of red corpuscles and plasma must remain during health in very fine adjustment. For were the red corpuscles to become decidedly either specifically lighter or heavier than the plasma, they must crowd against the vessel walls and the frictional resistance thus offered to the circulation might readily exceed the power of the heart to overcome.

It does not seem improbable that a disturbance of the specific gravity of the blood plasma in extensive albuminuria is the direct cause of the inflammations of different kinds, such as pleurisy, pneumonia, &c., to which there is a great tendency in that disorder. The tendency to hypertrophy in the left ventricle of the heart, and to general dropsy, may be explained in the same way.

In Asiatic cholera the water is rapidly drained from the blood, and the speedy collapse may have its solution in the clogging of the blood-vessels with corpuscles that are crowded against their walls.—*Journ. of Physiology, Vol.* v, *p. 66, 1884.*

PSYCHOLOGY.

Emotional Faculties of Animals.—It will be observed, on turning to the diagram, that I attribute to animals the following emotions, which I name in the probable order of their historical development: Surprise, fear, sexual and parental affection, social feelings, pugnacity, industry, curiosity, jealousy, anger, play, affection, sympathy, emulation, pride, resentment, æsthetic love of ornament, terror, grief, hate, cruelty, benevolence, revenge, rage,

shame, remorse, deceit, ludicrous. This list, which leaves many of the human emotions without mention, exhausts all the emotions of which I have found any evidence in the psychology of animals. Before presenting this evidence in detail, perhaps it will not be thought superfluous again to insist that in attributing this and that emotion to such and such an animal, we can depend only upon inference drawn from actions, and that this inference necessarily becomes of less and less validity as we pass through the animal kingdom to organisms less and less like our own; so that, for instance, when we get as low down as the insects, I think the most we can confidently assert is, that the known facts of human psychology furnish the best available pattern of the probable facts of insect psychology. Still, as the known facts of human psychology furnish the best available pattern, we must here, while treating of the emotional faculties, follow the same method which we have hitherto followed while treating of the intellectual faculties, viz., while having full regard to the progressive weakening of the analogy from human to brute psychology as we recede through the animal kingdom downwards from man, nevertheless using the analogy, as far as it goes, as the only instrument of analysis that we possess.

I shall now proceed, as briefly as possible, to render the evidence which has induced me to ascribe each of the above named emotions to animals, and remembering that I have in each case written the emotion upon the diagram at the level of mental evolution where I have found the earliest evidence of its occurrence, it follows that in the majority of cases the emotion is present in the higher levels of mental evolution in a more highly developed form.

It will be observed that in the diagram I represent the emotions, as a class, to take their origin from the growing structure of mind at the same level as that at which the faculty of perception takes its origin. I do this because I think that as soon as an animal or a young child is able to perceive its sensations, it must be able to perceive pleasures and pains; hence, when the antecedents of a painful perception recur in consciousness, the animal or child must anticipate the recurrence of that perception—must suffer an ideal representation of the pains, and such suffering is fear. And that, as a matter of fact, fear of this low or vague order is manifested at about the second or third week of infancy, is the general opinion of those who have most carefully observed the development of infant psychology. To specify the class in the animal kingdom where a true emotion of fear arises is clearly a more difficult matter, and indeed it is impossible to do so in the absence of any definite knowledge as to the class in which perception first arises. But while, as previously explained, I am not able to say whether or not the Cœlenterata, and still less the Echinodermata, are able to perceive their sensations, I think the

evidence becomes very strong in the case of insect larvæ and worms. And that both the one and the other manifest striking symptoms of alarm in the presence of danger may be easily shown.

With reference to young children, Preyer is of opinion that the earliest emotion is one of surprise or astonishment upon perceiving any change or strikingly novel feature in the environment. In deference to his opinion, therefore, I have placed surprise upon the same level of emotional development as fear, but of course in both cases this level is so low that it is but the germs of such emotions that are here supposed to be present.

This earliest stage of emotional development (18) I have made to correspond with "emotions preservative of self." The next stage (19) I made to coincide with the origin of "emotions preservative of species;" and of these the first to appear are the sexual. In the animal kingdom—or rather let us say in the psychological scale—these emotions are first unequivocally exhibited by the Mollusca, which on this account, as well as for the reasons given while treating of the association of ideas, I have made to fill the corresponding level on the other side of the diagram.

The next level (20) is occupied by parental affection, social feelings, pugnacity, emotions conducing to sexual selection, industry and curiosity. The level, therefore, corresponds with the origin of the branch marked social emotions in the central psychological tree, and with the earliest recognition of offspring on the side of the intellectual faculties. The animals which first satisfy all these conditions are the insects and spiders. For here, even if we exclude the Hymenoptera, we have evidence of parental affection in the care which spiders, earwigs and sundry other insects take of their eggs and broods. Again, numberless species of insects are highly social in their habits; others are highly pugnacious; some are conspicuously industrious; most flying insects display curiosity; and, according to Mr. Darwin's elaborate inquiries, it is also in this class that we find the earliest evidence of sexual selection.

Coming now to level 21, I have assigned to it the first appearance of the emotions of jealousy, anger and play, which unquestionably occur in fish. On level 23 I have placed the dawn of affection other than sexual, in view of the evidence of the emotional attachment of a python which was exhibited toward those who had kept it as a pet.

On level 24 I have placed the dawn of sympathy, seeing that this emotion seems to be unquestionably, though very fitfully, displayed by the Hymenoptera, which for other reasons I have felt obliged to assign to this comparatively high stage of psychological development.

On the next level (25) I have given emulation, pride, resentment, æsthetic love of ornament, and terror as distinguished from

fear. All these emotions, so far as I have been able to ascertain, first occur in birds; and in this class some of the emotions which I have already named as occurring in lower classes are much more highly developed.

Next we arrive at grief, hate, cruelty and benevolence, as first displayed in some of the more intelligent of the Mammalia. Grief is shown by pining, even to death, upon the removal of a favorite master or companion; hate by persistent resentment; cruelty by a cat's treatment of a mouse; and benevolence by the following instances which I have met with since the publication of Animal Intelligence. Writing of a domestic cat, Mr. Oswald Fitch says, that it "was observed to take out some fish bones from the house to the garden and, being followed, was seen to have placed them in front of a miserably thin and evidently hungry strange cat who was devouring them; not satisfied with that our cat returned, procured a fresh supply, and repeated its charitable offer, which was apparently as gratefully accepted. This act of benevolence over, our cat returned to its customary dining place, the scullery, and ate its own dinner of the remainder of the bones." An almost precisely similar case has been independently communicated to me by Dr. Allen Thomson, F.R.S. The only difference was, that Dr. Thomson's cat drew the attention of the cook to the famishing stranger outside by pulling her dress and leading her to the place; when the cook supplied the hungry cat with some food, the other one paraded round and round while the meal was being discussed, purring loudly. One further instance of the display of benevolent feeling by a cat will suffice. Mr. H. A. Macpherson writes me that in 1876 he had an old male cat and a kitten aged a few months. The cat, who had long been a favorite, was jealous of the kitten and "showed considerable aversion to it." One day the floor of a room in the basement of the house was partly taken up in order to repair some pipes. The day after the boards had been replaced the cat "entered the kitchen (he lived almost wholly on the drawing-room floor above), rubbed against the cook and mewed without ceasing until he had engaged her attention. He then, by running to and fro, drew her to the room in which the work had taken place. The servant was puzzled until she heard a faint mew from beneath her feet. On the boards being lifted the kitten emerged safe and sound, though half starved. The cat watched the proceeding with the greatest interest until the kitten was released; but on ascertaining that it was safe he at once left the room without evincing any pleasure at its return. Nor did he subsequently become really friendly with it."

On the next level I have placed revenge as distinguished from resentment, and rage as distinguished from anger. In Animal Intelligence I give some cases of apparent vindictiveness occurring in birds; but as the exact nature of the emotions in these

cases appears to me somewhat doubtful, I here disregard them, and place revenge on the psychological level which is occupied by the elephant and monkeys, in which animals this passion is very conspicuous. The same remarks apply to rage as distinguished from the less violent display of hostile feeling which is suitably expressed by the term anger.

Lastly, at level 28 we arrive at the highest products of emotional development which are manifested in animal psychology, and therefore at the highest of those products with which the present treatise is concerned. These are shame, remorse, deceit and the emotion of the ludicrous. For instances of the display of these emotions by dogs and apes, I need merely again to refer to Animal Intelligence.

In this brief sketch of the emotional faculties as they occur in the animal kingdom, my aim has been to give a generic rather than a specific representation. I have therefore omitted all details of the emotional character of this or that particular animal, as well as the narration of particular instances of the display of emotions.—*Romanes' Mental Evolution.*

THE MEASUREMENT OF HUMAN FACULTY.—Mr. F. Galton, M.A., F.R.S., delivered, reports the *English Mechanic*, the Rede lecture at Cambridge, last spring, taking for his subject "The measurement of human faculty." After briefly describing the art of measuring human faculties as the "dawn of a new and interesting science," Mr. Galton said that his new evidence, which he had taken some pains to obtain, showed that the actions of men are "governed by cause and effect;" but if the conduct of man is the result of some external influence, then such knowledge as he has obtained is of little service. Mr. Galton concluded by suggesting that a laboratory should be opened at Cambridge to investigate this "new science." An anthropometrical laboratory will be opened at the Health Exhibition by Mr. Galton.

ANTHROPOLOGY.[1]

THE ANNALS OF CHIMALPAHIN.—Domingo Francisco de Saint Anton de Chimalpahin, born in 1579, was a Mexican. He was descended from the kings of the State of Tzacualtitlan-Tenanco-Amaquecan, whose first sovereign reigned 1269–1338. Chimalpahin was versed in astronomy, history, geography, and in the study of the antiquities of his country. He composed in Nahuatl, by the aid of our alphabet, eight relations, or annals. They form part of the collection of Boturini. They were found by Aubin and their publication commenced. M. Rémi Siméon was associated with Aubin and copied a part of the annals. They are chronological tables, containing, besides the genealogies of kings, princes, princesses and lords, mention of the principal political

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

events of his country. In the second relation the author commences the history of the Chichimecs at the time when they debarked on the Gulf of California.—[Le Muséon, III, 334.]

THE BOARD OF INDIAN COMMISSIONERS.—Although the especial function of this board is not anthropological, the thoughtful student of the natural history of our race will find much food in their report for serious thought. We all believe in the continuity of history. As we look at the fragmentary story of the past, we wonder how those heterogeneous events could ever have formed part of a single mosaic. In the report of 1883, pp. 8–33, is a picture of a struggle going on in the Creek nation between the party of progress and the party that sigh for the flesh pots of Egypt.

"Tantæ molis erat Romanam condere gentem."

THE HEALTH REPORT OF WASHINGTON.—The report of the health officer of Washington is doubtless a parallel with the similar publications in most of our well regulated cities. The growing complexity of our civilization is well exhibited by the measures taken to defend human life and happiness against the perils arising out of our greatest comforts. A report of this kind is also a good barometer to indicate whether we are advancing or retreating in social strength. For instance, when the health officer informs us that the increase of calls on the public dispensary is greater than the increase of population, we at once see that public morals are declining. When he informs us that the colored applicants are twice in number those that are white, while the white population doubles the colored, we know that pauperism is four times as great among the colored people. The most accurate information comes from the mortality tables, which foot up as follows for eight years:

	Population.			Deaths.			Death-rates.		
	White.	Colored	Total.	Whi	Col.	Tot.	Whi.	Col.	Total.
1876	106,741	50,859	157,600	2090	2072	4162	19.58	40.74	26 35
1877	109,505	52,870	162,375	2190	2014	4204	20.00	37.39	25.89
1878	112,340	54,960	167,300	2167	2068	4235	19.29	37.63	25.32
1879	115,247	57,053	172,300	2196	2113	4309	19.06	37.03	25.00
1880	118,236	59,402	177,638	2085	2121	4207	17.63	35.71	23.68
1881	121,300	61,760	183,060	2205	1931	4136	18.18	31.27	22.59
1882	124,441	64,212	188,653	2353	2218	4571	18.91	34.54	24.23
1883	126,300	65,680	191,980	2270	2016	4286	17.98	30.68	22.33
Mean annual rate							18.83	35.62	24.42

It is impossible to compare this with births, because while the death list is accurate, the health officer cannot get the correct birth list. In the foregoing table it will be noticed that the white rate is fluctuating, but decreasing; the colored death rate has steadily diminished, showing a decided improvement in prosperity and hygiene. Of 3116 births reported, 851 were white

males; 833 white females; 715 colored males; 715 colored females. Of 353 bastards reported, 300 were colored. Of [illegible] white births 1004 were certified by physicians, while of 143 colored births only 295 are returned by physicians, and of this number 126 are from the hospitals.

THE INDIAN OFFICE REPORT.—Among the various ways of viewing the social transformations of any people, one that is easily taken and that will lead to good results, is the comparison of tribes, at various epochs, as to their wants and their demands upon their conquerors. In the treaty with the Six Nations, dated January 21, 1795, the United States guarantees $3000 in addition to $1500 allowed April 3, 1792, for clothing, domestic animals, implements of husbandry and useful artificers. The series of artificers in nearly all the tribes has been as follows. 1. Gunsmiths, to help the savages to perform old functions with new tools; 2. Blacksmiths, who taught rude husbandry and paved the way for, 3. The miller and the schoolmaster. The missionaries, both Catholic and Protestant, taught the Indians to read and to repeat service both in English and Indian from the first. From the beginning of the century differentiation of functions and multiplication of wants have increased until the present commissioner's report of crops and other products of Indian labor; of horses, mules, cattle, swine, sheep and domestic fowls; of goods consumed, such as bacon, beef, vegetables, grain, coffee (365,000 lbs.), flour and salt (1,000,000 lbs.); of fabrics, such as blankets, clothing, household fabrics (1985 mosquito bars), shoes, hats and notions; of groceries (25,000 lbs. baking powder and 149,690 lbs. of soap are included); and of crockery, furniture, harness and agricultural implements occupies 110 pages. A very instructive paper on sociology could be made out of these figures. The report of education is most encouraging:

School population exclusive of civilized tribes		35,883
Number who can be accommodated in boarding schools		5,182
" " " " day "		6,032
Boarding schools		117
Night "		2
Pupils in school one month or more	Boarding 5139	10,241
	Day 5102	683
Teachers and employés		
Cost of schools, Govt. $361,185, Religious societies $70,588, New York $17,512, employés $160		$449,445
Indians who can read		14,399
School children in civilized tribes		11,450
Sittings: boarding schools 1269, day schools 6330		7,599
Boarding schools		14
Day schools		199
Boarding pupils		1,284
Day pupils		3,700
Cost to Five Nations $162,030, to religious societies $13,57[illegible]		8$175,608
Can read in the tribes		32,050

There is but one suggestion to make with reference to the

commissioner's reports. Much of the space that is filled with mere gossip and unpractical advice from agents might be the repository of the most useful ethnological information.

THE INDIAN MUSEUM AT CALCUTTA.—Dr. John Anderson has issued Part II of the Catalogue and hand-book of the archæological collections of the Indian Museum. Gupta and inscription galleries, Buddhist, Jain, Brahmanical and Muhammadan, sculptures; metal weapons, objects from tumuli, etc. Calcutta, printed by order of the trustees, 1883. The volume contains 521 pages, and is much more than a list of articles. Some one has said that a well ordered museum is a collection of carefully prepared labels with specimens attached. Dr. Wilson has not only brought to his work a great deal of learning, but has also called to his aid several distinguished specialists. It is impossible to single out any part of the volume for an example, where all is so well done.

A NEW JOURNAL.—The following is the title of a new journal of comparative philology: *Internationale Zeitschrift für allgemeine Sprachwissenschaft*, unter mitwirkung der Herren [L. Adam and many others] herausgegeben von F. Techmer, docenten der allgemeinen Sprachwissenschaft an der Universitat Leipzig. 1 Band, 1 Heft. Leipzig, Joh. Ambr. Barth, 1884.

The following papers appeared in the first number:

Introduction to general philology. By A. F. Pott. Philosophical side; Origin of language, general grammer; physical side; psychical side; natural history—psychical side; classification of languages, pp. 1–68.

Scientific analysis and synthesis of audible speech. By F. Techmer. Speech from without as it approaches us; acoustic, analysis and synthesis; Speech from within outward: Anatomical and physiological genesis of speech, the windpipe, glottis, nose, palate, tongue, mouth. The classification of vowel and consonant sounds; the syllable, symphony, pp. 69–170.

The articles following are short notices and reproductions. The papers by Pott and Techmer are both thoroughly done. Since Max Müller began to publish rude maps of the mouth in his discussions on language, there has been great improvement in the correlating of physiology and glossology. But F. Techmer has given us the most thorough discussion and illustration of this subject. One hardly knows, when he is looking at the illustrations, whether he has in hand a treatise on language or a text book on anatomy.

ANTHROPOLOGY IN FRANCE.—With the current year *Materiaux* commences Vol. I, 3d series. The first two numbers present the following valuable memoirs:

Study of some Hallstattian necropoles in Austria and in Italy. By Ernest Chantre. [pp. 1–27, 31 figures of pottery and bronze objects. Quite a number of new forms are presented.]

History of prehistoric anthropology. Cuvier and the antiquity of man. By Emile Cartailhac. [pp. 27–34. This is a defence of Cuvier against Mortillet's charge of having opposed the theory of the antiquity of man.]

The Ethnogeny of Western Europe. By Dr. Hamy. [pp. 35–48. The paper is the opening discourse at the Museum of Paris. The subjects to be considered are: 1. Natural classification; 2. Linguistic classification; 3. Chronological classification. In the latter will be considered prehistoric races, contemporaneous with extinct animals; the neolithic peoples, builders of the dolmens, the Iberians, the Ligurians, the Celts, the Romans, Germans, Franks, Saxons and Normans. Incidentally the Slavs, Fins, Hungarians and Turks will receive attention.]

M. Martinet reviews several works of importance on the archæology of South America. (pp. 49–57.)

Discovery of prehistoric quarries for silex. By Marcellin Boule. (pp. 65–75.)

The Société d'Anthropologie de Paris has elected, for 1884, M. Hamy, president, and Dr. Paul Topinard, general secretary.

Revue Scientifique publishes a paper, by Lombroso, upon anthropology and criminality (No. 10, pp. 303–308), in which he reviews the works of Lacassagne, Ferri, Manouvrier, Heger and Dallemagne, Orchanski and many others.

Further Discoveries of Perforated Crania in Michigan.—During the last two years excavations in various mounds along the Detroit river, in the vicinity of the city of Detroit, have brought to light a number of instances, in addition to those which I have already noted and to which I first called attention many years ago, of the peculiar burial custom of perforating the skull of the deceased. While this additional material strongly corroborates the deductions based upon my former discoveries, notwithstanding the most careful investigation, I am unable to contribute any new information throwing light on the special significance of the custom. As in former cases not all the skulls taken from a single depository were distinguished by this peculiar mark. Without a single exception in these latter specimens, as in all others which I have examined where perforated, the opening is exactly centered in the top of the skull. This tends to confirm my early assumption that whatever may have been the primary object of the custom, whether it points to a religious observance, or is indicative of caste simply—a mark of honor, &c., it included, in all probability, the suspension of the cranium. The nicety with which the position of the aperture is established is remarkable, it never being in the least to one side of the center. In the few instances where three holes were found, the extra two were placed near the central perforation, and at equal distances on each side of it, thus preserving the equilibrium.

In these last examples the perforation is of the smaller size, in every case being less than half an inch in diameter. The crania are of the orthocephalic type, and where the other bones were recovered, they were found to present most of the peculiarities which I have recorded as pertaining in similar instances to my former discoveries, extremely flattened tibiæ being the most decided abnormality observed. The platycnemism is posterior.

In a communication received by me in July, 1876, from the

late M. Paul Broca, whose recent death, shortly after his election as a life senator of France, is so great a loss to science and especially to anthropology, the illustrious savant coincides with my opinion, long previously expressed, as to the Neolithic trepanning found in the caves of France having no connection with the cranial perforation observed by me in Michigan. A translation of his running comparison of the two sorts of perforations, elicited by the publication of my discoveries, having made some slight changes and additions, rendered necessary by my fuller information and the acquisition of new material, I here append for the benefit of those who may not have access to my papers on the subject:

Of the Neolithic perforations of France.—1. Some are surgical, others were made after death.

2. Both sexes and all ages, including infants and children, were subjects.

3. They are from three to five centimeters in length on the head of adults, with very oblique and cicatrized edges.

4. The position is variable.

5. The posthumous were made by the aid of an instrument moved like a saw, detaching the fragment, &c.

6. Object of the posthumous: To secure the fragments, which were used for amulets.

Of the perforations in the ancient crania of Michigan.—1. All were made after death.

2. They are confined to adult subjects, and probably the male sex.

3. They are generally from about one to two centimeters[1] in diameter, with oblique but not cicatrized edges.

4. The position is constant—centrally placed at the top of the head, and always on the sagittal suture, or at its juncture with the coronal suture.

5. They were made probably with an instrument turning principally semicircularly.

6. Object unknown (perhaps the extraction of the brain, perhaps the suspension of the head).

There is no evidence that the parts removed were preserved, or that even they were cut out entire.

It is remarkable that, so far, the discovery of the American perforations has been confined, perhaps with a single exception, to the mounds in Michigan. It seems probable, however, tha proper researches would reveal similar relics from mounds on the Canada shores of the Detroit river and Lake Huron.

Those who may be interested in a more extended discussion of this interesting custom, I refer to the following mentioned of my

[1] The smallest of the perforations which I have as yet seen is about one-third of an inch in diameter; the largest, of elliptical form, has the major diameter eight-tenths of an inch.—*H. G.*

papers which treat of the subject: "Certain characteristics pertaining to ancient man in Michigan," Smithsonian Report for 1875; "The ancient men of the Great Lakes," read before the Detroit meeting of the American Association, August, 187; "Additional facts concerning artificial perforation of the cranium," &c., Proceedings of the American Association, August, 1875.

In a future paper I hope to be able to give some facts of more or less interest with reference to the bones, &c., found in connection with the crania last discovered.—*Henry Gillman, Detroit, Michigan.*

THE ARUBA LANGUAGE AND THE PAPIAMENTO JARGON.—*The Aruba language.*—Aruba is the westernmost isle of the group of islands called the "Lesser Antilles," which extends along the northern coast of South America at a short distance from the mainland. It lies north of the Peninsula of Paraguana, Venezuela, and northeast of the entrance to the Gulf of Maracaibo; it belongs to the dominion of the Dutch in the West Indies, which extends over the following islands: Aruba (preferable to the orthography Oruba), Curaçao, Curaçilla at the south-eastern cape of Curaçao, Bonaire or Buen Aire, and the two Aves or Bird islands. Curaçao is the largest island of the archipelago, and consists of a barren rock almost devoid of vegetation; the capital of the Dutch colony, Wilhelmstadt, is built on its southwestern shore. In former times the thrifty inhabitants accumulated wealth as the mediators of a lively smuggling trade between the Spanish and the other colonies of the West Indies. Salt is now the staple produce of Curaçao with its 22,000 inhabitants; as to its size, it is nearly three times larger than Aruba, which has 200 square kilometers and 5670 inhabitants.

The explorer Alphonse L. Pinart, through whose kindness some linguistic material was obtained, visited the Curaçao group in the summer of 1882. Although the natives of Aruba have since A. D. 1800 abandoned their paternal language for the Papiamento jargon, their exterior is still of a pure Indian type. The Aruban language was probably the same as that of Curaçao and related to the vernacular of the peninsula of Paraguana. From natives far advanced in age, Pinart succeeded in obtaining a few terms of the Aruban language and of local nomenclature, also six sorcerers' formulas, and from the Papiamento, as spoken at present, he secured a limited number of plant and animal names evidently pertaining to the extinct Indian dialect, the number of which may be easily increased by future travelers.

An old Aruba Indian, recently deceased, witnessed at the former Indian encampment at Saboneta the inhumation of a native female in one of the large conical ollas, her body being doubled up within the vase and the head protruding through the orifice. A smaller urn was then placed upon the head, bottom up, and the whole covered with earth. Several Aruban grottos and rock

shelters yielded inscriptions and pictographs to the explorer, who considers their style as related to the pictography of the Orinoco and Apure countries. Fragments of pottery, hatchets made of shells and stones are profusely scattered around the ancient encampments of the native Arubans.

The name of *Curaçao* island seems to be the Tupi word coaracy', curassé, *sun*, in Guarani, quaraçi; *Aruba* resembles the name of a shrub which is called in French Guyana *arube*. Nicolas Fort y Roldan, in his "Cuba *indigena*" (Madrid, 1881), p. 125, gives *arabo* as the name of a plant as heard on one of the Great Antilles.

The Papiamento.—On account of the peculiar selection and association of their ingredients, and the grammatic changes which the terms are undergoing, the jargons or medley languages are now being studied by linguists with the interest they deserve. The best known jargons of America are the conversational Tupi or "lingoa geral," the various negro jargons of Guyana, of the West Indies and of Louisiana, the Chinook jargon, etc.; in the early stages of their formation English, Turkish and Neopersian were jargons also. The main ingredient of Papiamento, which is spoken upon Aruba, Curaçao and the rest of this island group, is the Spanish language; then comes Dutch, the language of the Netherlandish rulers, and least in frequency are the words of Indian origin.

The character of this medley speech will best appear from a Conversational Guide, which has been published at Curaçao, 1876.—*A. S. Gatschet.*

MICROSCOPY AND HISTOLOGY.[1]

MYRTILLUS, A NEW DYE FOR ANIMAL AND VEGETABLE TISSUES.—Dr. M. Lavdowsky[2] recommends the juice of fresh huckleberries, *Vaccinium* (Gaylussacia Gray) *myrtillus*, as an excellent staining medium, especially for the caryokinetic figures and the cellulose walls of plant cells.

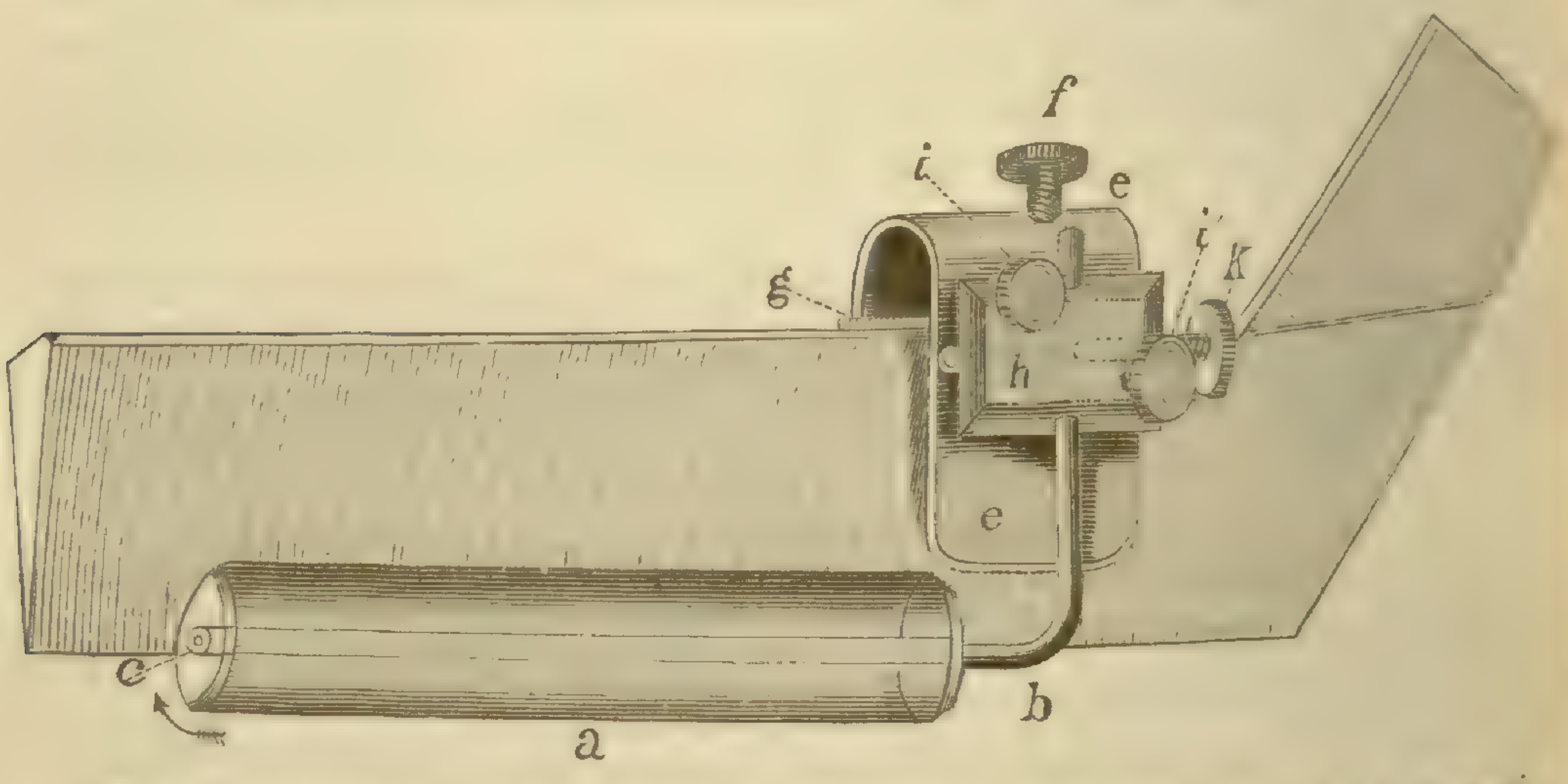
Preparation.—The newly picked berries should be washed in water, then the juice expressed and mixed with twice its volume of distilled water containing a few grams of ninety per cent alcohol. The mixture may next be boiled for a short time, then filtered while it is still warm. The fluid thus obtained is deep red and slightly acid, and may be kept in well corked bottles for a long time, if not left in too warm places. The fluid becomes somewhat thick on cooling, and may therefore be diluted with 2–3 times its volume of distilled water at the time of using.

Two different colors are produced by this fluid: 1. *A red color* is produced by the action of the fluid on fresh objects, *and on objects hardened in chromic acid or other chromic solutions.* The

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.
[2] *Arch. f. Mik. Anat.*, XXIII, pp 506–508.

best staining is said to be obtained from chromic acid preparations. 2. *A lilac color*—more durable than the red—may be obtained in the following manner: Place three watch-glasses on a white ground, fill one with the myrtillus fluid, the second with a one per cent solution of acetate of lead, and the third with distilled water. Place the object in the dye for one or two minutes, wash in the distilled water, then leave in the solution of acetate of lead until the lilac color becomes pronounced; finally wash and mount in glycerine or, after treatment with alcohol, in balsam. In case glycerine be used, a little acetate of lead should be mixed with it.

A NEW SECTION-FLATTENER.—Dr. F. Decker[1] has invented a section-flattener which presents an important improvement on those hitherto described in this journal. The flattener is a cylindrical glass roller (*a*) which rotates on a brass rod (*b*).



The diameter of the rod is 2$^{mm.}$ slightly less than the lumen of the roller, so that the latter rotates easily and evenly.

A steel plate (*e*) bent so that the two arms clasp the blade firmly, forms a carrier for the roller and its shaft. The carrier is slipped on at the free end of the blade, and the pressure of its arms strengthened by means of the screw (*f*), the inner end of which bears against a narrow strip of steel (*g*). To the upper arm of the carrier a brass block (*h*) is attached by means of a hinge which runs lengthwise along the middle of the under side of the block. The short arm of the brass rod (*b*) passes through the middle of the block in a horizontal direction, and is fixed in any position by means of the screw (*k*). The distance of the glass roller from the edge of the knife is regulated by the screws *i* and *i'*. If one of these screws is raised and the other lowered one half of the block (*h*) will be raised and the other half lowered, and the distance between the roller and the blade correspondingly altered. The length of the glass cylinder (*a*) is 5$^{cm.}$ its diameter should vary according to the size of the object to be

[1] Ein neuer Schnittstrecker. *Arch. f. Mik. Anat.*, XXIII, pp. 537–543, 1884.

sectioned. Three cylinders, measuring 4, 6 and 9^{mm} in diameter, will be found sufficient for all ordinary purposes.

The apparatus above described can be adjusted to knives of different microtomes. It may be obtained from Gustav Stöber in Würzburg.

The Distomian Brood-sac or Sporocyst.—Our knowledge of the life-cycle of the digenic trematodes has become nearly complete through the researches of Leuckart, Thomas, Schauinsland and Biehringer. Schauinsland was the first to trace the development of the trematode embryo from the egg; and Leuckart and Thomas nearly completed the story by giving us the history of the liver-fluke through the heteromorphic generations that begin with the embryo and end in the sexually developed fluke. Biehringer's recent paper supplements our knowledge of the sporocyst and its brood in one or two important particulars.[1]

Structure of the sporocyst.—The typical sporocyst is composed of three layers: 1. The outer thin layer, for a long time regarded as a cuticle and sometimes compared to the basal membrane of planarians, is shown by Biehringer to contain nuclei, and hence it must be regarded as a true epidermis, comparable with the *hypodermis* of other worms. Hitherto the ciliated mantle of the embryo, which is thrown off during the transformation into a sporocyst, has been held to represent the entire ectoderm (epidermis), and hence the sporocyst was supposed to be without an ectodermic layer. Biehringer takes a more rational view, holding that the ciliated mantle represents only the outer layer of the ectoderm, comparable to the outer epithelial layer of the larva of an echinoderm or a nemertine. The so-called cuticula of the cercarian larva is also shown to be not a cuticula but an epidermis.

2. Beneath the epidermis there is a thin muscular layer consisting of an outer stratum of transverse (circular) fibers and an inner stratum of longitudinal fibers.

3. The inner layer, which forms the chief part of the wall of the sporocyst, may be called a *germinal epithelium*.

Some sporocysts have a fourth layer enveloping the three just named; but this layer, as was long ago pointed out by Leuckart, forms no part of the proper wall of the sporocyst. Biehringer has for the first time determined the precise origin of this accessory membrane. *It is formed from the blood corpuscles of the host.*

Origin of the Germ-cells of the Sporocyst.—There is a wide difference of opinion between Leuckart and others as to the origin and nature of the cells which give rise to the young brood in the mature sporocyst. The free-swimming distomian embryo is completely filled with coarsely granular cells, which are the direct

[1] Joachim Biehringer. Beitrage zur Anat. u. Entw'gesch. d. Trematoden. *Semper's Arbeiten*, VII, 1884, pp 1-26.

descendants of the cleavage-cells. Leuckart holds that these are the germ-cells of the next generation, and that their number remains the same when the sporocyst stage is reached. Thomas also regards these as germ-cells, but thinks that their number is augmented by germ-cells derived from the epithelial layer which lines the cavity of the sporocyst. According to Leuckart then the germ-cells are ready formed from the outset; but according to Thomas some are ready formed while others have an epithelial origin.

Biehringer has settled definitely that germ-cells do arise in the epithelium, but leaves the question of a two fold origin of germ-cells still open, not having been able to trace the history of the cells which fill the interior of the embryo.

A cell in any portion of the epithelium divides into two cells, the plane of division cutting the axis of the sporocyst at right angles, as in Fig. 1 *g*. Further division gives four, eight cells, &c., ending in the formation of a morula-like mass which escapes from the epithelial layer into the central cavity, and here completes its development. This mode of reproduction is to all appearances asexual, and may be regarded as a process of internal budding. The developmental cycle of the trematode is therefore, according to Biehringer, a true alternation of generations.

FIGS. 1, 2 and 3 show portions of the wall of a sporocyst with epithelial cells (*g*) in different stages of cleavage. *e*, epidermis; *ep*, epithelium; *m*, musculature; *g*, germ-cells developing.

THE DEVELOPMENT OF THE JAWS OF BRANCHIOBDELLA AND A METHOD OF ISOLATING THEM.[1]—The jaws, of which there are two, one dorsal and one ventral, are formed on small papillæ as cuticular secretions. The papillæ represent slightly thickened areas of the epithelium lining the œsophagus. The jaws then are merely thickened portions of the general cuticula which covers the whole of the external surface of the worm as well as the epithelium of the œsophagus.

The five or more denticles on the lateral and posterior edges of the jaw are each the product of a single cell which is slightly longer than the other cells of the papilla.

In order to isolate the jaws and with them the entire cuticular mantle, it is only necessary to leave a Branchiobdella in an empty watch-glass until it has dried, and then cover it with water. The cuticula will expand to its original size, leaving the shrunken animal inclosed as in a sack. The sack can then be cut through the middle and the animal easily removed by slight pressure with the aid of a small brush. The jaws will then be seen cohering with the œsophageal portion of the cuticular sack.

[1] Walter Voigt. *Semper's Arbeiten*, VII, pp. 47 and 54-55, 1884.

SCIENTIFIC NEWS.

— We have received a description, by Professor Alfred C. Haddon, of an apparatus for demonstrating systems of classification. What he proposes is very simple, merely consisting of a series of glass plates placed vertically over one another, leaving a small space between each, and a number of small movable blocks. The exact method for supporting the glass plates is of no consequence, and may be varied to any extent. The apparatus which he employs "consists of an oblong mahogany board, let into the corners of which are four brass sockets; into these are inserted four brass standards which are pierced with holes at regular intervals in such a manner that the holes in each end-standard are *vis à vis* with those of its fellow, and are at the same time parallel with those at the opposite end. Through these holes brass wires are inserted, and it is upon these that the glass plates rest. This apparatus has the advantage of being readily taken to pieces, and being quite portable. The names should be printed on paper, then cut out and pasted on two faces of oblong blocks of wood in such a manner that they can be read in a front view or by looking down vertically upon the apparatus. A makeshift may be constructed by bending a small oblong piece of cardboard roofwise and writing the name on one face of the anticlinal. The several blocks may be linked together in the same plane by pins placed either vertically or obliquely, and reaching to the upper glass plate. Any complicated system of linkage is thus possible.

"In a classification of recent forms, each plate might represent a stage of differentiation, and the arrangement of the forms on that superficies would indicate their inter-relationships. The lower planes would naturally be chosen for the less differentiated types. An area on each plane could always be made by a colored line to represent some special modification. Degraded animals might be tinted, and a black pin slanting from the higher to the degenerate form would graphically show that it was not an ascending type. Missing links between more or less widely separated living animals could be appropriately supplied by names within brackets.

"For phylogeny the arrangement would be somewhat similar except that each plate would represent some geological horizon, the name of which would be on a block placed in one corner. Every name in each geological epoch should be tinted in some distinctive color, so as to distinguish at a glance its precise horizon.

"The philosophical palæontologist arranges the names on each plane so as to indicate the relations of each animal to those preceding and succeeding it in time, as well as to its synchronous neighbors, and thus he gets a graphic view of the march of life; by looking from above down the vista of time he sees widely separated recent animals gradually converging till they all unite in

some form which, if at present unknown, must once have existed; or, more accurately, diverging from such a common ancestor. It will also be made apparent that in every age there were forms which varied from the parent stem which lived for a longer or a shorter period and then became extinct.

"Very valuable museum demonstrations could be made by fitting up a comparatively large apparatus to the glass plates of which were cemented real fossils with their names. Ammonites and Brachiopods, for instance, are well fitted for this purpose. Affinities and variations would in this case be illustrated by the actual specimens, and so be vividly impressed upon the mind."—*Proc. Royal Dublin Society.*

— The Ottawa Field Naturalists' Club evinces its activity in promptly issuing its Transactions, Vol. II, No. I. The club has for four years maintained a strictly local character, and to this is ascribed whatever success it has attained. The subjects treated refer to the local flora of Ottawa, the sand plains of the Upper Ottawa, the fossils of Ottawa, edible and poisonous fungi, a list of the Coleoptera of Ottawa, and the deer of Ottawa valley, with reports of the different branches or sections into which the society is subdivided. If every city in America had such a local, enterprising society, and there are a few which have, what an increased interest in and respect for the study of nature would pervade our people! Its effects would be seen in our common schools; it would ameliorate the degrading materialism of our times, tone down the love of display and lavish expenditure in moneyed circles, and here and there give room for the growth and development of trained observers of nature.

— The records of the Society of Naturalists of the Eastern United States, vol. I, part I, Boston, 1884, contains the constitution and by-laws with a list of members; a copy of the original call for the organization of the society; with the records of the first meeting at Springfield, Mass., and the second meeting at New York, Dec. 27 and 28, 1883.

— A department of veterinary medicine and surgery has been recently established in connection with the University of Pennsylvania. Dr. R. S. Huidekoper has been placed in charge.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for Advancement of Science, Philadelphia meeting, Sept. 4–11, 1884.

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Musical sand, its wide distribution and properties. H. Carrington Bolton and Alexis A. Julien.
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THE

AMERICAN NATURALIST.

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ROCK INSCRIPTIONS IN BRAZIL.[1]

BY JOHN C. BRANNER.

IN 1876 I visited Aguas Bellas, a small town in the interior of the province of Pernambuco, and about a hundred miles from the coast, for the purpose of examining localities said to contain the remains of extinct mammals.

The fossils were found at and in the vicinity of a cattle ranch known as Lagôa da Lagea, eight leagues east of Aguas Bellas. During the time spent at this place I learned of several rocks in the vicinity bearing inscriptions which, it was said, no man could read. I took time to visit the most convenient of these localities and to make careful drawings of the markings, the characteristic ones of which are here represented (Plates XXXIV-VI).

The first place visited for this purpose was a small farm about a league from Lagôa da Lagea, known as Cacimba Circada. The rock found at this place, together with its inscription, is shown at *k* (Plate XXXIV). This rock is a gneiss boulder of decomposition, about 10′ × 6′ × 6′, lying upon the bed rock near the Rio Garanhunzinho. On the right, as one faces the inscription, is an asterisk a foot in diameter, made by four lines crossing each other at equal angles, while the remainder of the inscription on the left consists of three rows of marks or indentations that run down from near the top

[1] The present contribution is intended to supplement the work begun by my friend and teacher, the lamented Professor Ch. Fred. Hartt, who was deeply interested in the archæological and ethnological work yet to be done in Brazil. It was while working upon the Imperial Geological Commission of Brazil, and under his directions, that these observations were made.

The NATURALIST for May, 1871, contains an article by Professor Hartt upon Brazilian rock inscriptions.

of the rock about two and one-half feet to where a portion of the block has split off from the lower left corner, probably carrying away part of the inscription. It is impossible to determine the exact number of these points, for some of them, especially those next the top, have become very indistinct through the weathering of the face of the rock. The inscriptions appear to have been made by pecking with stone implements, and in the case of the asterisk the stone was rubbed up and down the line until the furrows were well polished. After being ground out these points and lines were painted, the color now having a dull red or brown appearance.

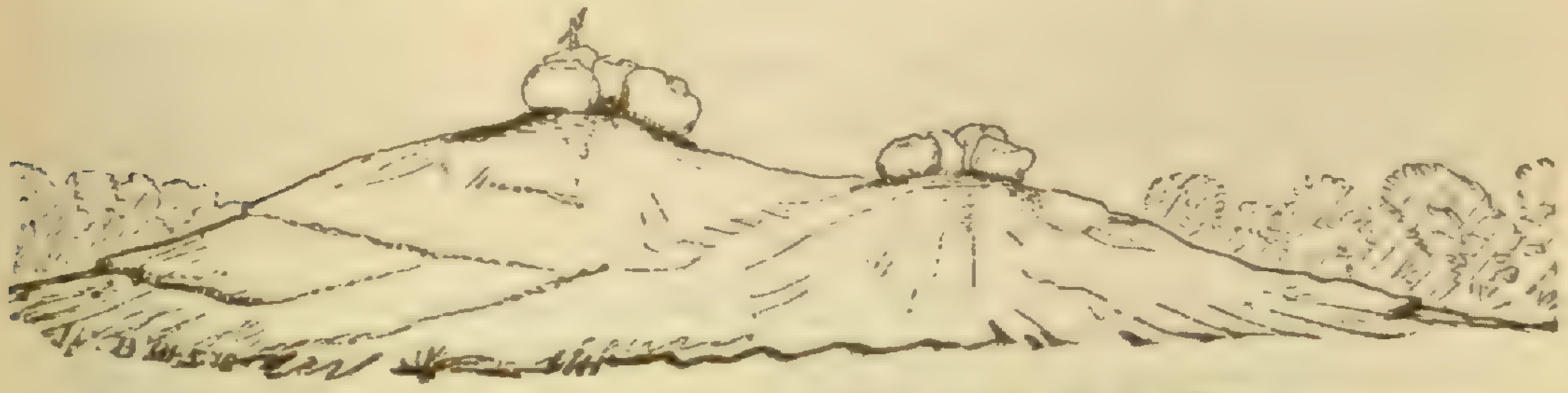
The next place visited was Pedra Pintada (painted stone) which is located upon a stream (during the rainy season) taking its name from the marked stones—Rio da Pedra Pintada.[1] It is said to be ten leagues from Aguas Bellas, twelve from Garanhuns and nine from Papacaça. There are here about forty designs engraved, and part of them both engraved and painted upon the large blocks of gneiss on the banks, and upon the flat smooth rock in the dry bed of the stream. There is a cascade about twenty-five feet high just here, and at the foot of it a pot-hole, now filled up, which is about fifteen feet wide by as many deep, and to the presence of which these inscriptions are possibly due, as I shall show. The forms of the inscriptions are shown in the figures, which are drawn to scale, and I need not describe them in detail. Figs. *a*, *b*, *c*, *d*, *e*, *f*, *r* and *s* are engraved on the bed rock of the stream above the cascade. These are not painted, and if they ever were, the paint has been washed off by the stream charged with sand and gravel. Many of these are becoming indistinct, some of them have almost entirely disappeared, while others have doubtless disappeared altogether. The concentric chipping of the rock, so common in the tropics, has also removed some of the inscriptions both in the bed of the stream and upon the banks.

The engraving appears to have been done like that at Cacimba Circada, by pecking and grinding with stones having thin rounded edges. After being thus polished these marks were painted, the color now showing as a dull red or brown. In some cases the points and lines are combined as is shown in *e* and *f*. The ar-

[1] Lower down this stream is called Riacho dos dois Riachos, and flows into the Ipanema at Sant' Anna, which enters the São Francisco about midway between Traipú and Pão d'Assucar.

rangement of points in parallel vertical lines is rather frequent, occurring several times here (Fig. *v*), as well as at Cacimba Circada (Fig. *k*), and at Sant' Anna (Fig. *x*). There aré several such rings as that shown at *e*, one of them having thirty-four points instead of thirty-six, while others are broken, or the points are too indistinct to be determined. There are two asterisks of eight rays, one associated with other markings (Fig. *v*) and another one independent, while still another asterisk has twenty rays (Fig. *p*). The only figure that seems to be intended to represent anything is Fig. *r*, which appears to be a rude representation of a spear-head. Part of Fig. *o* might be supposed to represent a fish, but I fancy that whatever resemblance there may be is accidental. The resemblance between some of these designs and some given by Professor Hartt[1] from the Amazon region is noteworthy, especially that of the spiral shown in *h* and that of the circle with the point at the center, such as are shown at *j*.

Returning from Aguas Bellas to the Rio Sao Francisco by way of the village of Sant' Anna, in the province of Alagôas, at half a league from this latter place I found the figures shown at *x* inscribed upon the side of a large gneiss boulder of decomposition. These figures are both cut and painted, and have the same dull red color as those at Pedra Pintada. There are other marks upon the vertical faces of this and of the other boulders of the group, evidently made by the same hands. These are simply polished spots varying in size from one to two feet in diameter. They are, for the most part, nearly round, but some of them are oblong, and none of them are more than about a quarter of an inch in depth—most of them not so deep, and are all painted. The stones upon which these inscriptions are made, as has already been stated, are gneiss boulders of decomposition, about a dozen in number, from six to twelve feet in height, and are grouped together upon the summit of a little hill of solid gneiss, as shown in the accompanying sketch.



The boulders near Sant' Anna, Province of Alagôas.

[1] American Naturalist, May, 1871.

Sant' Anna inscriptions.

The inscription *x* is upon the largest and most prominent of these boulders, while many, though not all the others, have polished places upon their sides such as I have described. During dry weather there is no water in the immediate vicinity, though the Ipanema[1] is only about a mile distant.

It should be noted that these inscriptions, as well as many others which I heard of through this part of the country, are all upon these large stones, and generally in some such prominent place.[2] One inscription in particular was mentioned to me by several persons, all of whom gave substantially the same account of it. This inscribed rock is near Agua Branca, twelve leagues above Piranhas and ten leagues from the falls of Paulo Affonso, on the *Fazenda da Caisára*, and is known as the *pedra navio*, or ship stone. It is said to be a large and nearly round boulder, standing upon a very narrow base upon the solid rock, and to have all its sides covered with Indian inscriptions.[3]

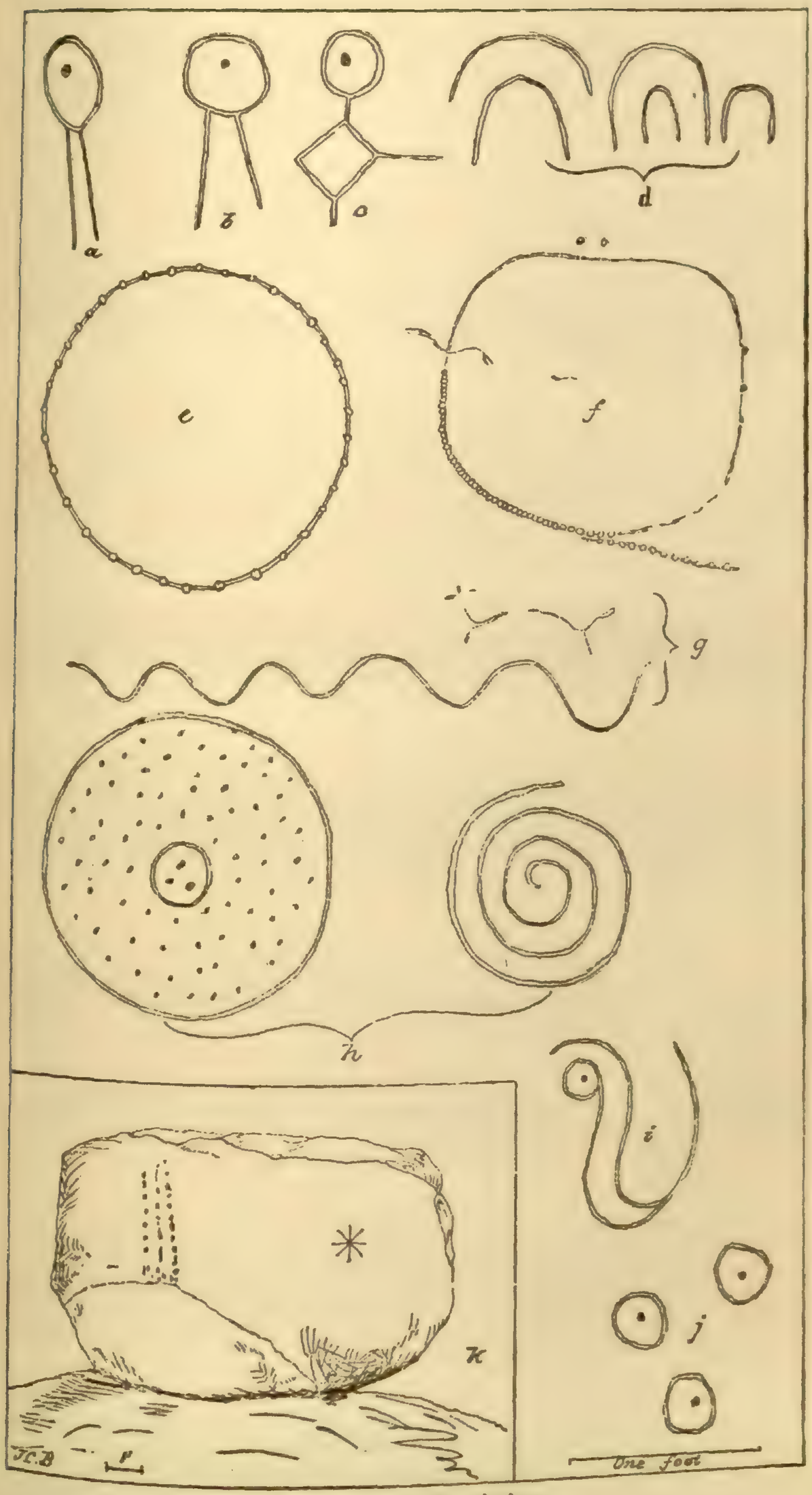
Through this part of the country, where the archæan rocks form a wide belt between the plateaus of the interior and the Cretaceous and Tertiary beds near the coast, these boulders of decomposition are not uncommon, and almost every one that I have seen has had some sort of artificial marks upon it, generally too badly eroded to be defined, but sufficiently distinct to leave no doubt concerning their origin.

Of the figures themselves I am unable to suggest any definite explanation. The explanations given by the people in the vicin-

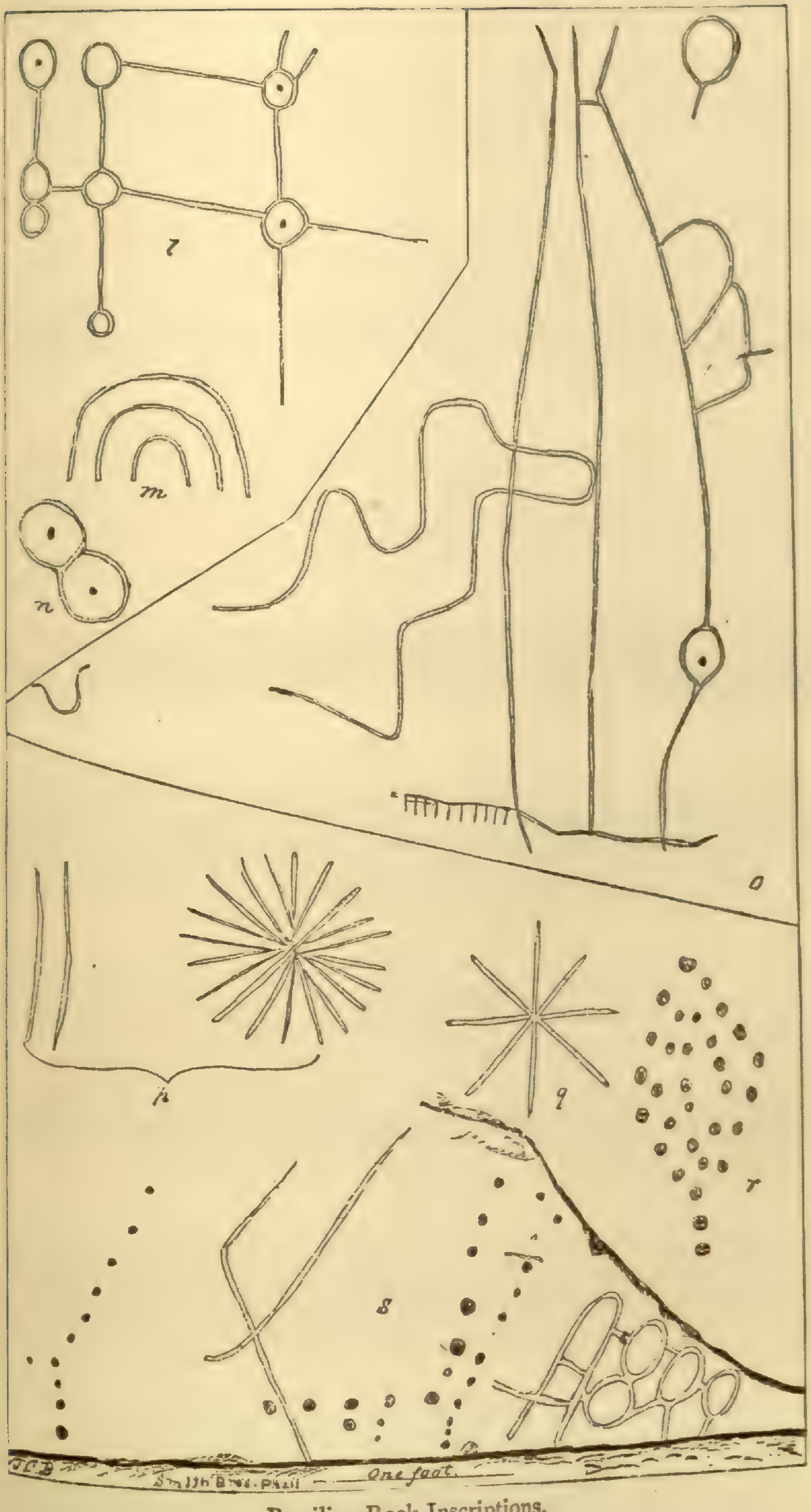
[1] Not "Panema" as the geographies give it.

[2] The inscribed rocks at Ereré described by Professor Hartt are also prominent ones.

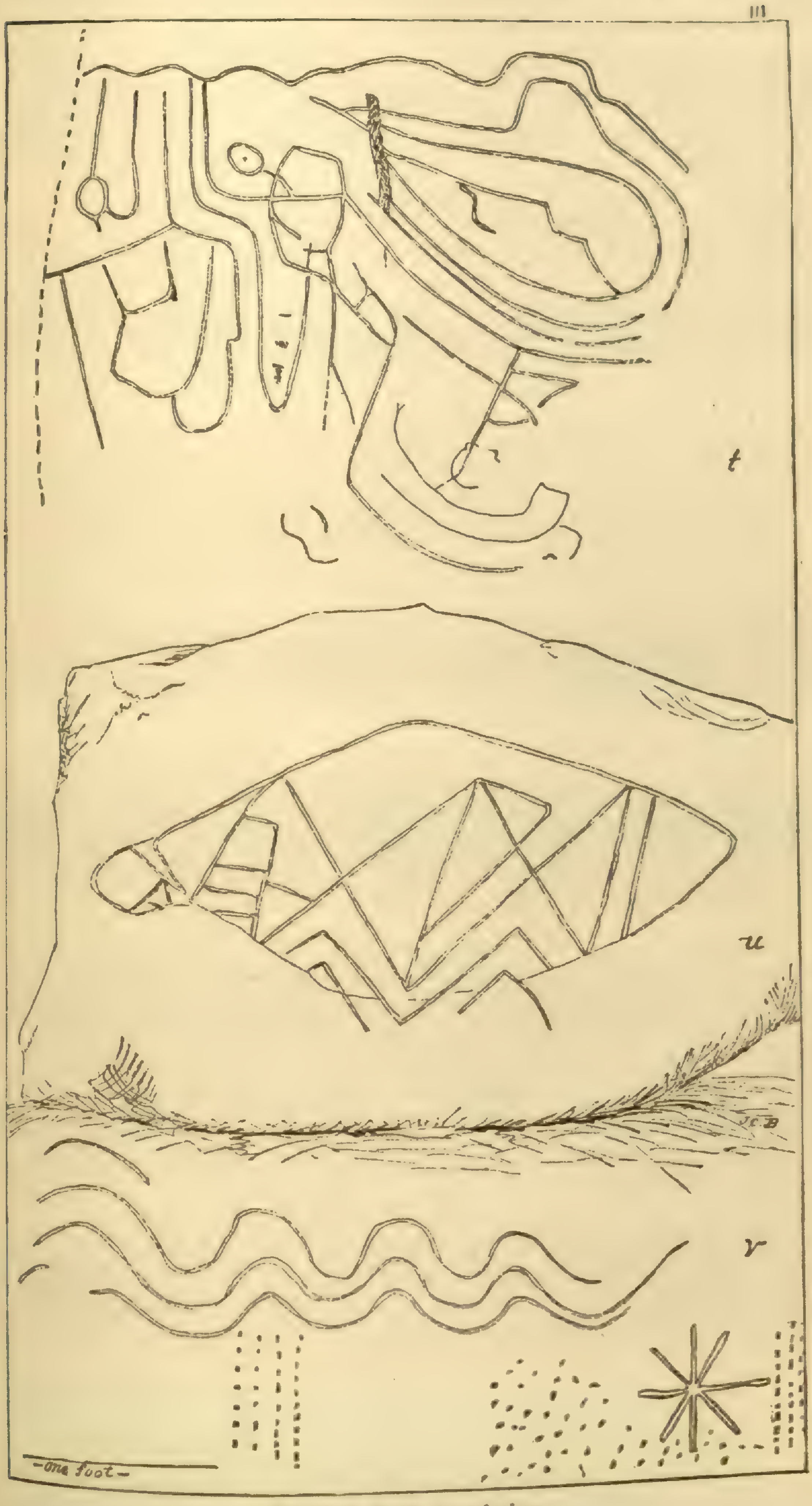
[3] I was told that there are extensive rock inscriptions further up the Rio São Francisco at Salgueiro on the Rio Quixába and at Ouricury, both in the western part of the province of Pernambuco. On the road between Diamantina and Beribery, in the province of Minas Geraes, are some rude Indian paintings of animals upon a ledge of rock. These latter I have seen, but had no opportunity of sketching them.



Brazilian Rock Inscriptions.



Brazilian Rock Inscriptions.



Brazilian Rock Inscriptions.

ity throw no light upon the subject. Some think they were made by the Dutch when they held the country about Pernambuco in the early part of the seventeenth century, but the general impression is that they refer to some treasure hidden in the neighborhood. This idea led a former proprietor of the country about Pedra Pintada to make diligent search for this supposed treasure, and he even cleaned out the great pot-hole at the foot of the cascade, but without finding anything.

It is to be noted, however, as far as I have observed, that these inscriptions are always near the water, or near a place where water is likely to be found late in, if not quite through the dry season.[1] At Pedra Pintada the pot-hole below the fall has water in it long after the stream proper has dried up, the Ipanema has never been known to dry up entirely at Sant' Anna, while Cacimba Circada (fenced spring) takes its name from a spring at that place. This occurrence of the inscriptions in the neighborhood of water might admit of more than one explanation. If they have no other relation to the water itself, they happen to be in these localities because these are the places where the original inhabitants of the country would naturally live during the dry season, which is here nearly half the year, and indeed a part of these inscriptions at least—those in the bed of the stream—must have been made during the dry season. I am, however, inclined to the opinion that a part if not all these markings refer in some way to the water supply which is so uncertain in this region of great drouths. Exactly in what way, whether as records of seasons, or as petitions or offerings to the powers supposed to bring rain, it is idle now to speculate. To one visiting this section during the dry season, which lasts from August till January, there is no more natural explanation. The whole country is parched except the cacti and a very narrow strip bordering the now dry beds of the streams. Beyond these threads of gradually disappearing green one may travel for leagues and leagues without seeing a sign of water, and when, as not infrequently happens, the dry season is prolonged, the suffering of man and beast is extreme. The cattle subsist upon the pulp of the cacti that grow here

[1] There can be no confusing these markings with the holes made in large stones by Indians grinding their corn, and which also occur near the water. Many excellent examples of these mortar holes were found by me at the foot of the Pão d'Assucar, on the Rio São Francisco. They are made in the upper surface of large fragments of rock near the river.

abundantly, while the herdsmen obtain water for them by digging holes in the sand of the river beds wherever water may be found in this manner. If the drouth still continues beyond this stage, the cattle are driven toward the coast to where water may be had, or they are left to perish of thirst.[1]

Without experience of such circumstances it is, perhaps, not easy to realize the force of the argument, but after riding for days through this region with a tropical sun blazing overhead, the atmosphere so dry that it seems to parch one's very vitals, and the heat from the glaring white sand quivering upwards to a cloudless sky, the thin *catinga* forest shriveled and still, with not a sign of animal life save the metallic stridulation of an occasional grasshopper, and after passing now and then a whole day without water, one realizes the importance which savage races, dwelling in such a country, would attach to a stream or pool where water could be had during the dry season.

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THE AMBLYPODA.

BY E. D. COPE.

(Continued from page 1121, November number.)[2]

PANTODONTA.

THERE is known as yet but a single family of this suborder, the Coryphodontidæ. Its representatives have been found in the lower lacustrine Eocene beds in Europe and North America in considerable abundance. About twenty species have been described, of which three have been found in England and France, and the remainder in the Rocky Mountain region of North America. They form a curious and interesting group of hoofed Mammalia which did not survive the Lower Eocene time, except in their probable descendants, the Dinocerata. The characters of the suborder have already been given in the NATURALIST, page 1111.

Five genera of the Coryphodontidæ are known from dental characters. Two of these, Coryphodon and Bathmodon, are known in their skeletal structure, the first-named very thoroughly.

[1] The circumstances under which I found the remains of extinct mammals in this region lead me to believe that their extermination was caused by long drouths over great areas.

[2] The explanations of Fig. 7 (p. 1115) should read four-ninths nat. size; not two thirds nat. size.

Bathmodon is nearest to the genus Pantolambda in its foot structure. The astragalus has the same subquadrate outline (compare Figs. 3 *d* and 19 *a*), and possesses, as in that genus, a facet on its internal anterior angle, for another bone. This character is found among recent Mammalia in certain rodents, where a separate bone, the internal navicular, articulates with the internal extremity of the astragalus. This is probably the case in Bathmodon and Pantolambda, but the separate bone has not been found. In Coryphodon it is evidently wanting, as the astragalus terminates internally in a hook-like apex, which gives it a very peculiar appearance (Fig. 2). Until I traced this astragalus to Coryphodon in 1873,[1] the relation of this genus to the Dinocerata had not been suspected.

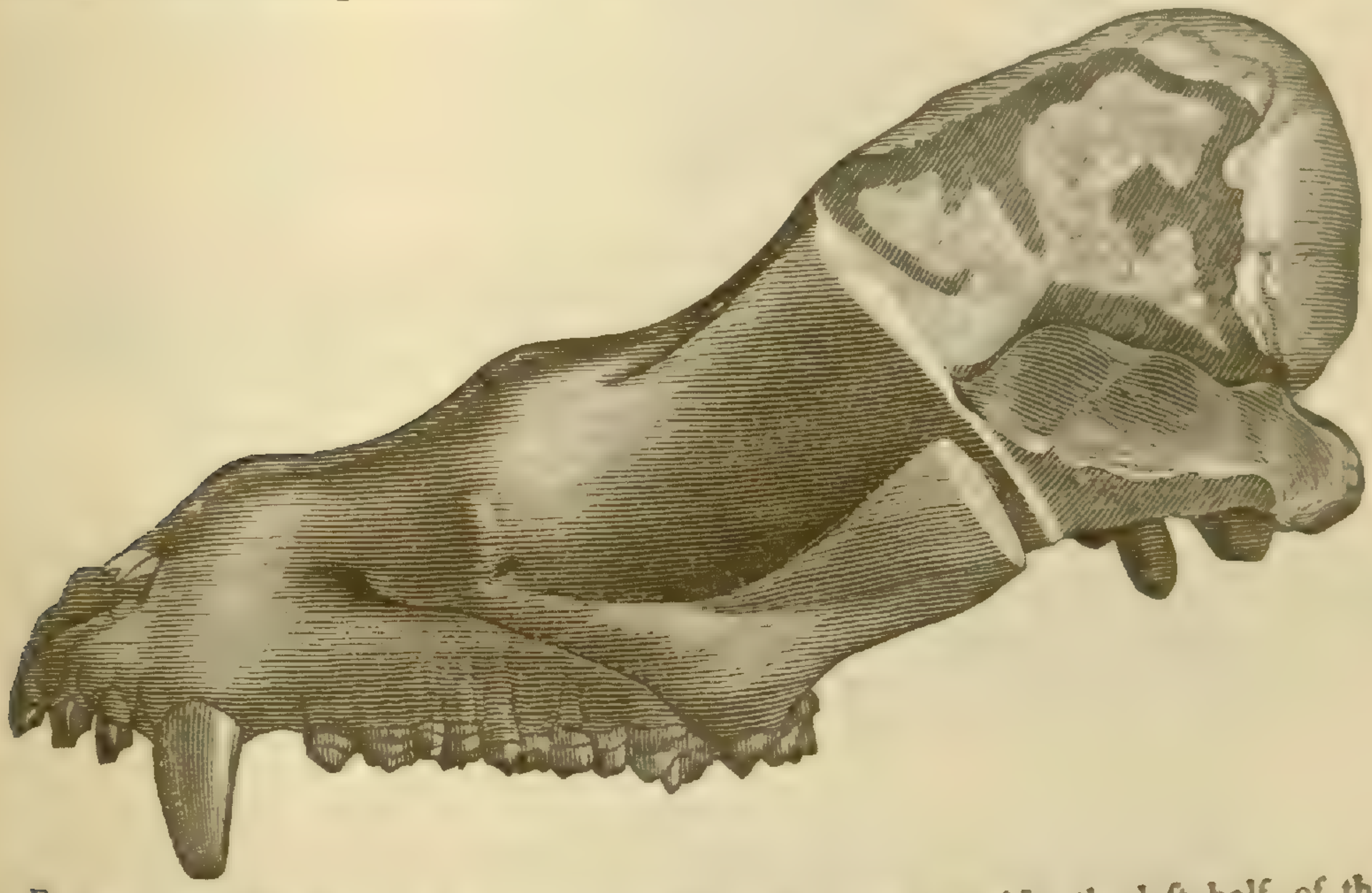

FIG. 12.—*Coryphodon elephantopus* Cope, skull from left side, the left half of the posterior part removed so as to display the small size of the brain cavity; two-ninths natural size. From Wasatch bed of New Mexico. Original.

The small size of the brain in this family is well displayed in the section of the skull of Coryphodon represented in Fig. 12, where the cavity it has occupied is exposed. Its relations to the skull are entirely different from those observed in all recent Mammalia excepting the elephants. As in them the diploë is represented by large air chambers.

The characters of the brain itself may be learned from Fig. 13. The exceedingly small size of the cerebral hemispheres at once arrests the attention, being much smaller than in the

[1] On the short-footed Ungulates of the Eocene of Wyoming. Proceedings Amer. Philosoph. Society.

cotemporary genus Phenacodus,[1] and agreeing with Uintatherium, which has been described by Marsh. There is no trace of sylvian fissure nor of convolutions. The middle brain is entirely exposed, and how much pertains to this and how much to the cerebellum remains uncertain. The anterior prolongation of the anterior pyramids is visible below the middle brain, as though the pons varolii were wanting (Fig. 13 *p*).

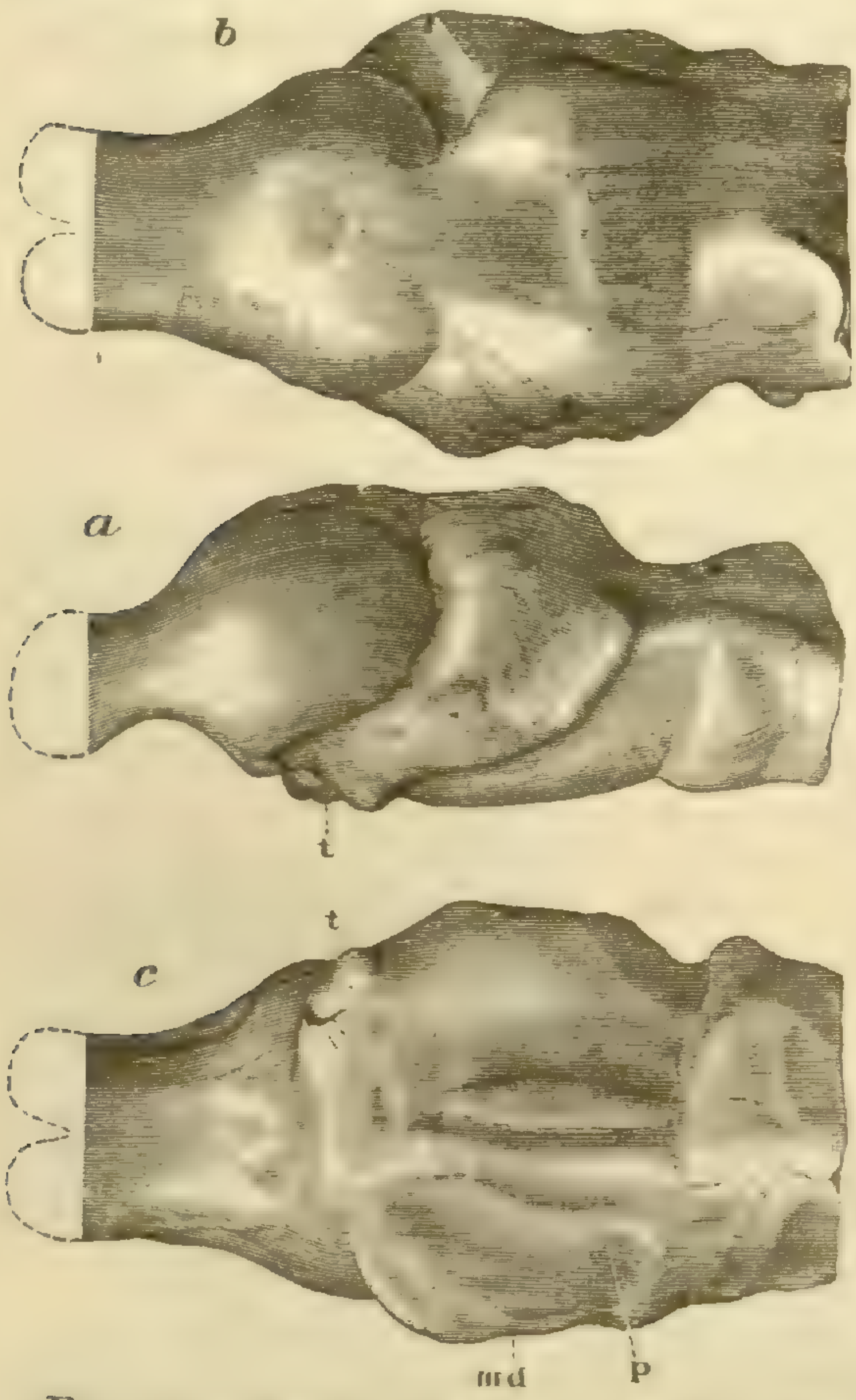

FIG. 13.—*Coryphodon elephantopus* Cope, cast of brain cavity seen in fig. 12, about one-third nat. size. Fig. *a*, left side; *b*, above; *c*, below. *t*, origin of trigeminus nerve; *p*, anterior pyramids. Original, from Proceed. Amer. Philos. Soc., 1877.

The characters of the long bones which are common to the members of this family may be observed in the *Bathmodon pachypus*, Figs. 14–15. The humerus shows the robust but not hooked tuberosities of the head, and the simple condyles. The radius shows the simple transverse head and the lateral distal facet. The femur (Fig. 15 *b*) has well developed trochanters, including the third, and a fossa ligamenti teris. The ilium (Fig. 15 *a*) like that of animals with a large belly, is much expanded, and has a wide peduncle. The pubis and ischium are light.

The five genera of Coryphodontidæ differ as follows:

I. Superior molars with two interior cusps.

All the superior molars with a well-marked external posterior V.....*Manteodon.*

II. Last superior molar with but one inner cusp or angle.

a. Last superior molar with posterior external cusp.

Anterior two molars with posterior external V.....*Ectacodon.*

aa. Last superior molar without external posterior cusp.

†Anterior two molars with posterior external V.

Astragalus transverse, with internal hook and no facet.....*Coryphodon.*

Astragalus subquadrate, with an internal facet and without internal hook, *Bathmodon.*

††First superior molar only, with posterior external V.....*Metalophodon.*

[1] See NATURALIST, 1884, p. 898, for figure.

The general relation of the teeth of these genera to those of other families of the order has been discussed (supra p. 1117). Their relation to each other may be understood by comparison of Fig. 9 *a* and *f* with Fig. 16. In the latter the anterior external V is marked a, and the posterior p. The posterior exterior angle of the latter is designated by the letter e. In Manteodon (Fig. 9 *f*) the posterior external V is observed to be well developed on the last superior molar. In Ectacodon (Fig. 16 *a*) its posterior edge is represented by an external cusp only (e), the rest of the border

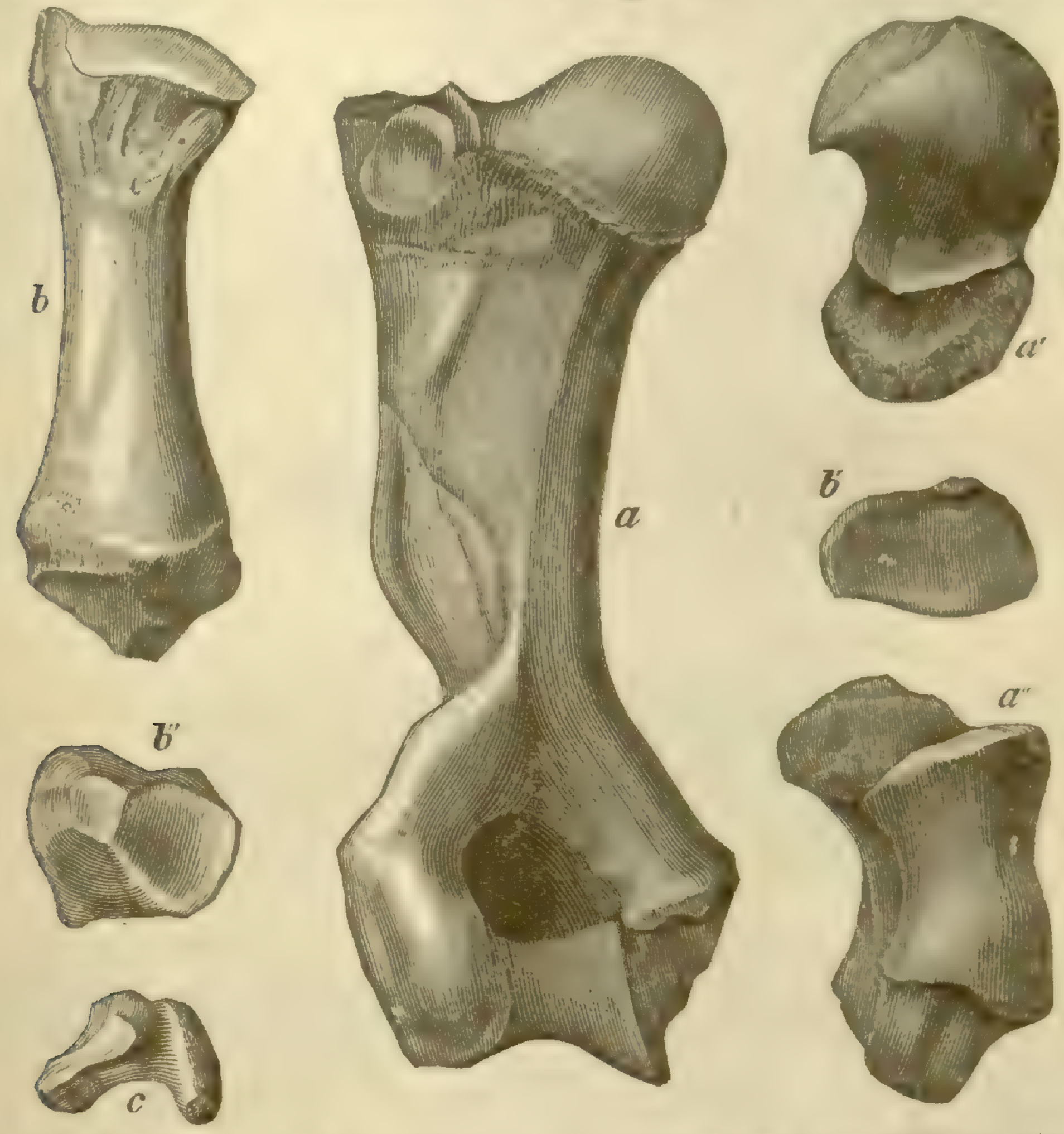

FIG. 14.—*Bathmodon pachypus* Cope, bones of fore limb, one-fifth nat. size, from Wasatch beds of Wyoming. Fig. *a*, left humerus from behind; *a'*, proximal, *a''*, distal views. Fig. *b*, left radius from behind; *b'*, proximal, *b''*, distal views; *c*, pisiform bone. From Vol. III Report U. S. Geol, Survey, F. V. Hayden.

being absent. In Coryphodon this border is sometimes traceable (*C. anax*, Fig. 9 *a*) or is wanting. In Metalophodon it is entirely absent, and is represented by a conical projection of the posterior crest only (Fig. 16 *b* p). The posterior V of the second superior molar is distinct in all except Metalophodon (Fig. 16 *b* p), where it is represented by a crest only, as in the last molar of most of the species of Coryphodon. The succession is thus seen to consist of the gradual conversion of the external Vs into

transverse crests, a process which is consummated in the Dinocerata of the later Bridger epoch (see Fig. 10).

Of Bathmodon two species are known, *B. radians* (Fig. 18) and *B. pachypus* (Figs. 14, 15 and 19). The latter is the larger,

FIG. 15.—*Bathmodon pachypus* Cope, bones of individual figured in Fig. 14, one-fifth nat. size. Fig. *a*, left innominatum, somewhat distorted, internal view; *b*, left femur from behind. Original, from Wasatch beds of Wyoming.

equaling a large ox in dimensions. The crania of these species are unfortunately unknown. Both are from the Wasatch beds of Wyoming.

Of Ectacodon Cope, but one species, the *E. cinctus*, has been

discovered. It is only known from the superior molar teeth fig-

FIG. 16.—Superior molar series of Coryphodontidæ, two-thirds nat. size, from the Wasatch beds of Wyoming. Original. Fig. *a*, *Ectacodon cinctus* Cope. Fig. *b*. *Metalophodon testis* Cope.

ured in Fig. 16 *a*. It is a large species, about equal to the *Bathmodon radians*.

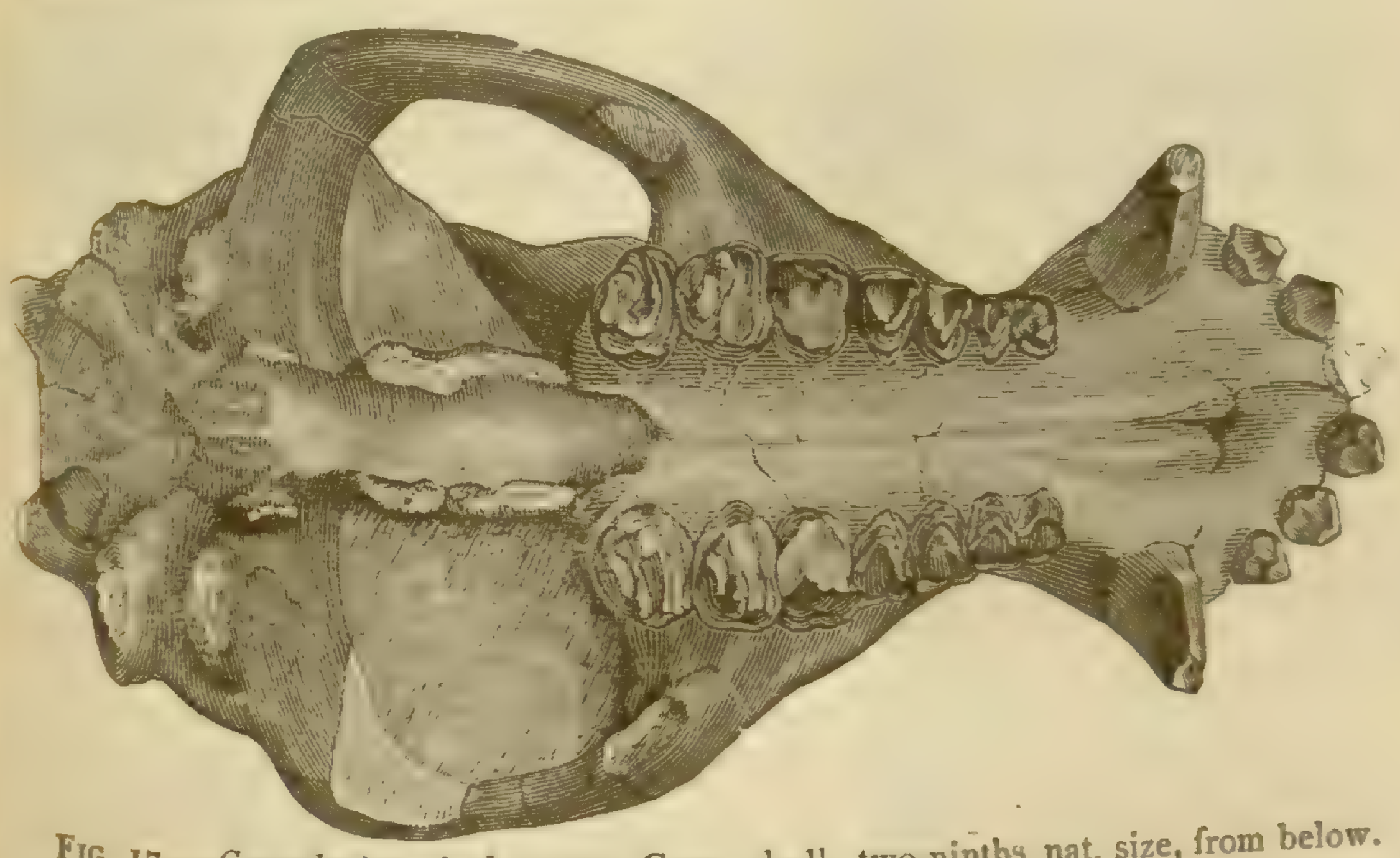

FIG. 17.—*Coryphodon elephantopus* Cope, skull, two-ninths nat. size, from below. Original, from Report G. M. Wheeler, U. S. G. G. Surv. W. of 100th mer., Vol. IV, pt. II.

The greater number of species of the family belong to Coryphodon. In this genus the temporal fossæ are lateral, as in modern ruminants, leaving a wide front with overhanging tem-

poral ridges (Figs. 20–21). The dental formula is the complete one of I. $\frac{3}{3}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$. The superior canines are very powerful, and have three sides, giving a triangular section. In some of the species (*C. molestus*), this tooth is more compressed

FIG. 18.—Lower jaw associated with the foot bones of *Bathmodon radians* Cope, from the Wasatch beds of Wyoming, three-eighths nat. size. From the small size of the canine probably a female. Original.

towards the apex, and the posterior face is narrow and concave, forming a groove. The inferior canines are also triangular in section, and the anterior angle is produced into an ala at the base (Figs. 9 *c*, 23 *i*). The neck and tail are of median length.

The general appearance of the Coryphodons, as determined by

the skeleton, probably resembled the bears more than any living animals, with the important exception that in their feet they were much like the elephants. To the general proportions of the bears must be added a tail of medium length. Whether they were covered with hair or not is, of course, uncertain; of their nearest living allies, the elephants, some were hairy and others naked. The top of the head was doubtless naked posteriorly, and in old animals may have been only covered by a thin epidermis, as in the crocodiles, thus presenting a rough, impenetrable front to antagonists.

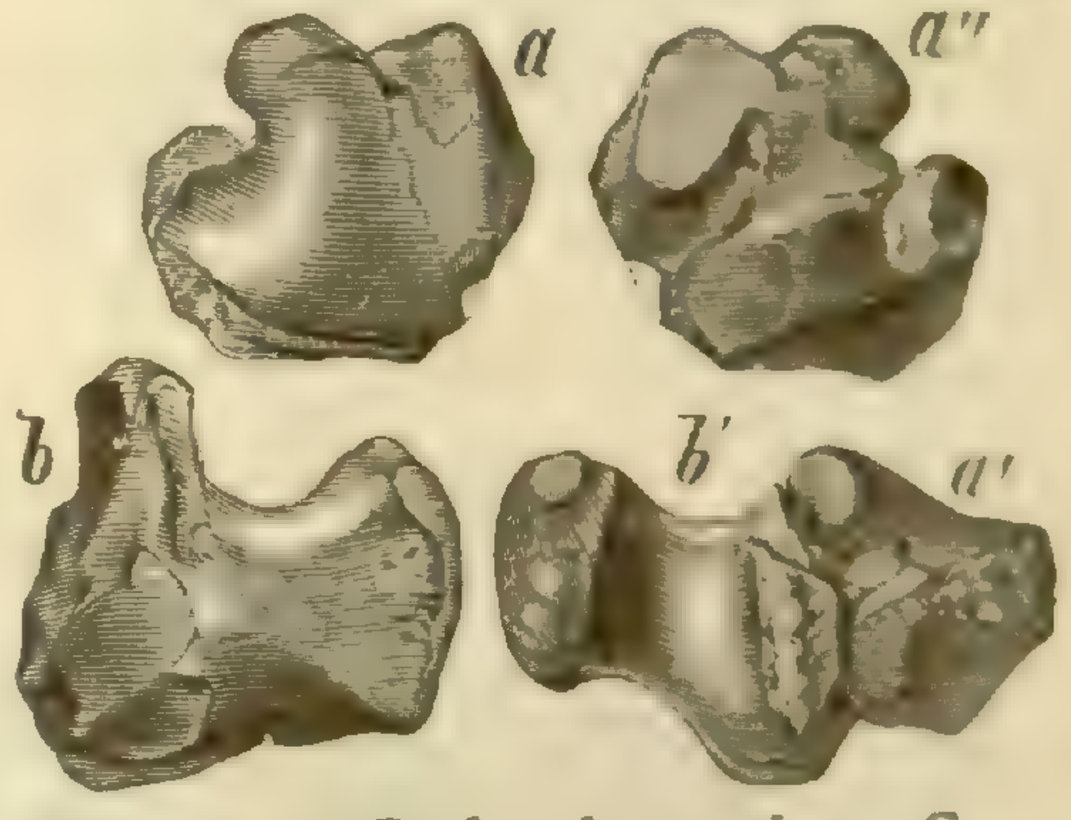

FIG. 19.—*Bathmodon pachypus* Cope, bones of foot of individual represented in figs. 14 and 15, one-fifth nat. size. Fig. *a*, astragalus from above; *a'*, inner side; *a''*, below. Figs. *b b'*, calcaneum.

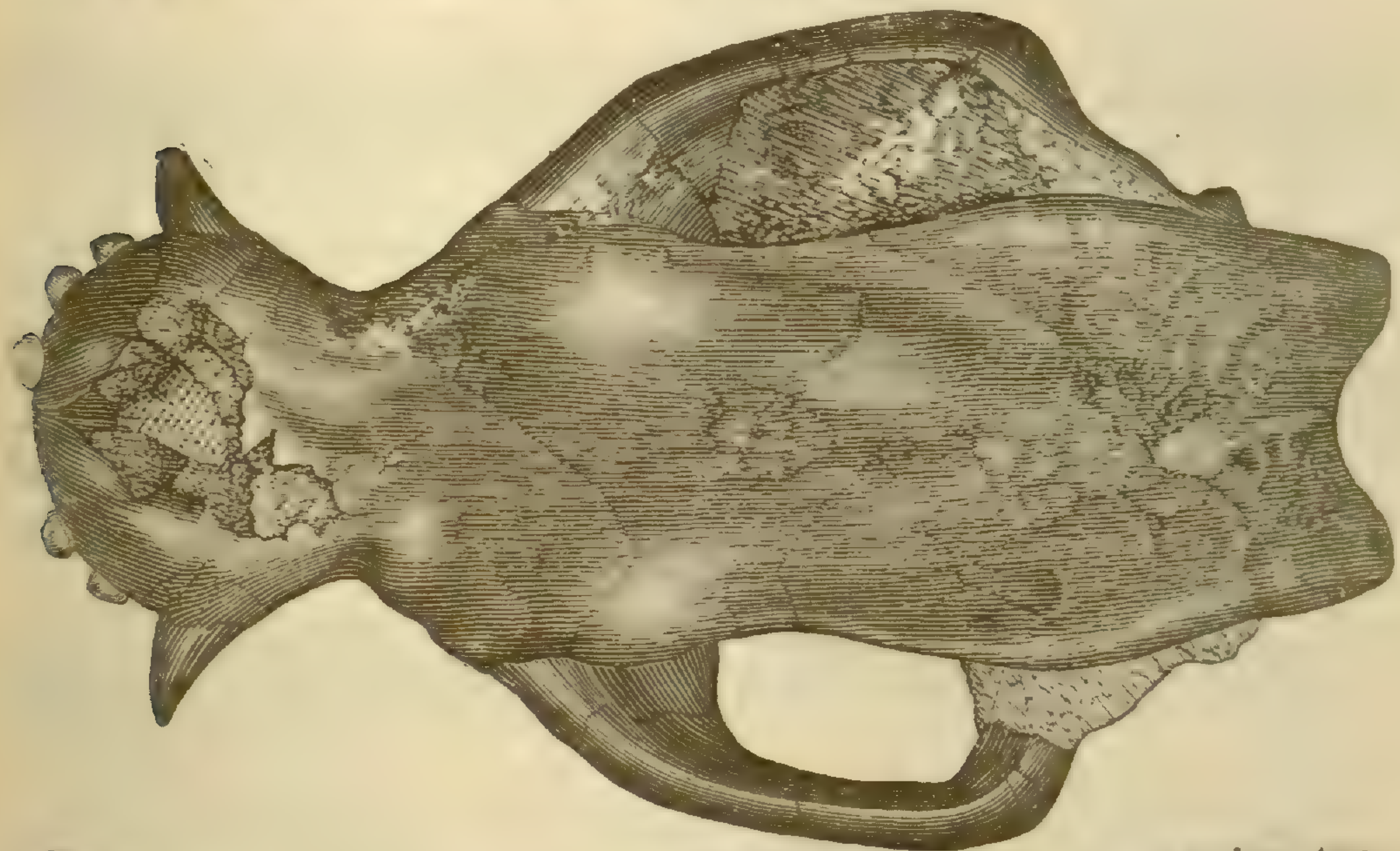

FIG. 20.—*Coryphodon elephantopus* Cope, skull figured in figs. 12, 17 and 21, two-ninths nat. size, from above. From Wasatch bed of New Mexico. Original, from Report U. S. G. G. Surveys and G. M. Wheeler, Vol. IV, pt. II.

The movements of the Coryphodons doubtless resembled those of the elephant in its shuffling and ambling gait, and may have been even more awkward from the inflexibility of the ankle. But in compensation for the probable lack of speed these animals were most formidably armed with tusks. These weapons, particularly those of the upper jaw, are more robust than those of the Carnivora, and generally more elongate, and attrition preserved rather than diminished their acuteness. The size of the species varied from that of a tapir to that of an ox.

We must suppose that the Coryphodons were vegetable feed-

FIG. 21.—*Coryphodon elephantopus* Cope, skull from left side, two ninths nat. size. From Wasatch bed of New Mexico. Original, from Report U. S. G. G. Survey W. of 100th mer., Vol. IV, pt. II.

FIG. 22.—*Coryphodon latidens* Cope, lower jaw, one-third natural size, from the Wasatch epoch of New Mexico. Fig. *a*, right ramus from internal side. Fig. *b*, both rami from above. Original, from Report U. S. G. G. Surveys W. of 100th Mer., G. M. Wheeler in charge. This specimen has an anomalous premolar.

ers, but not restricted to any particular class of food. They were doubtless, to a large extent, like the hogs, omnivorous.

Fourteen species of this genus have been described. They range in size from the dimensions of a tapir to those of an ox. In the absence of the bones of the skeleton the species may be distinguished by the inferior true molars, which are fortunately the parts most frequently preserved. The simplest form is that where the posterior crest of the posterior true molar is transverse, and there is no crest or cusp accessory to it on the inner edge of the crown, as in *C. latidens* (Fig. 22). A change in the form of this crest is seen in the *C. curvicristis*, where it is curved forwards at the inner extremity so as to enclose a crescent-shaped valley. This species adds several other peculiarities of this tooth, as the presence of two oblique crests in front of the anterior cross-crest (Fig. 22). The superior incisors are angulate on the external face. The species was of about the same size as the *C. latidens*.

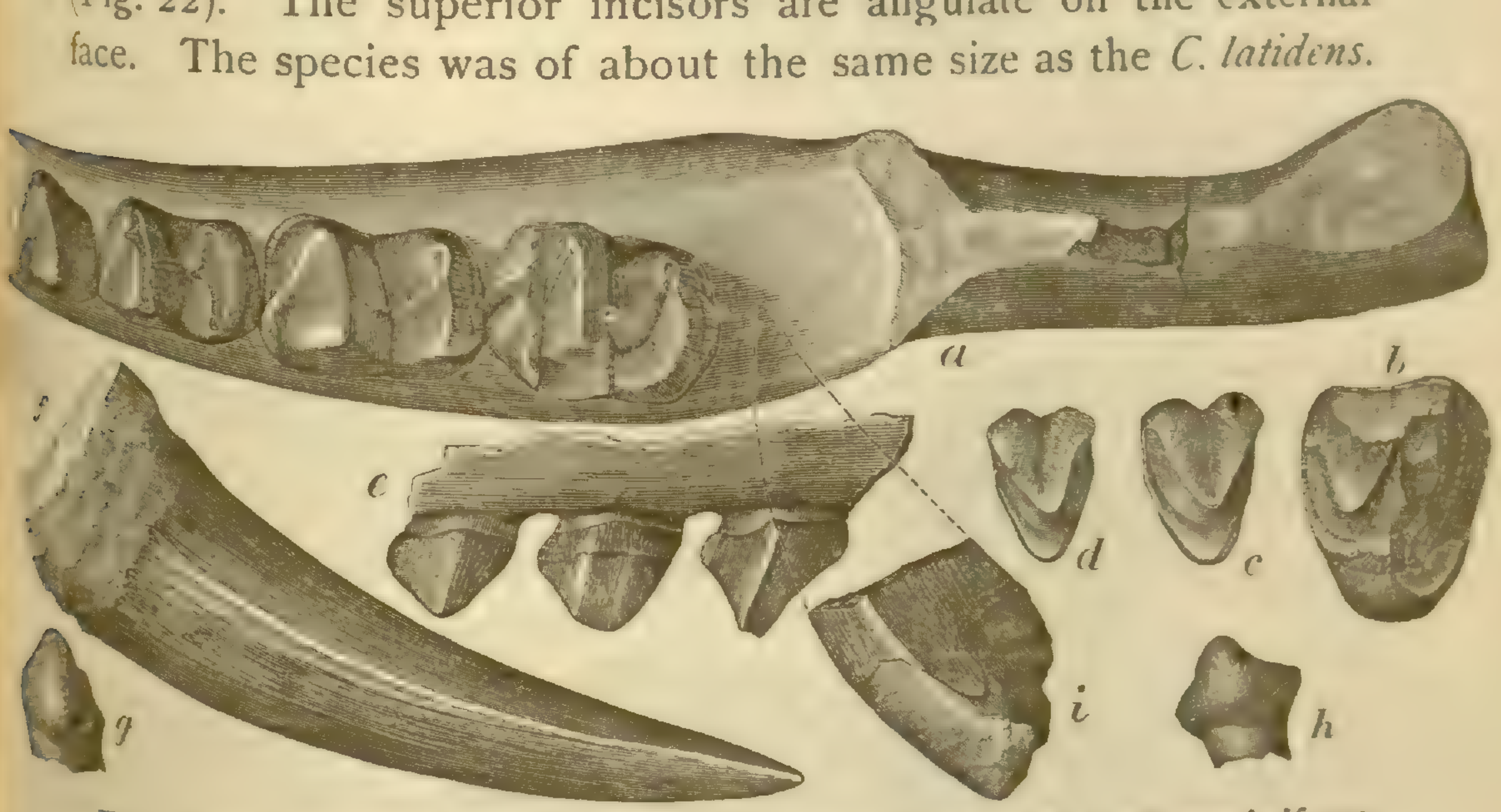

FIG. 22.—*Coryphodon curvicristis* Cope, portions of jaws with teeth, one half natural size, from the Wasatch bed of Wyoming. From Report U. S. Geolog. Survey Terrs., Vol. III. Original. Fig. *a*, right mandibular ramus with true molars and Pm. IV, from above. Fig. *b*, penultimate superior molar from below; *c d*, superior premolars from below; *e*, superior incisors, external side; *f*, superior canine, crown only; *g h*, inferior incisors, external views; *i*, inferior canine, base of crown.

The posterior cross-crest may send off the internal marginal crest at an angle, as in *C. eocænus* Ow., or *C. obliquus* Cope. The internal marginal crest may rise into a low tubercle, as in *C. lobatus* or *C. anax* (Fig. 23 and 9 *b d*). In this case the posterior cross-crest may be very oblique, as in *C. anax*, thus giving the appearance of a heel or fifth lobe to the crown. This is indeed the character of such a crown, which if compared with that of the *C. latidens* only might suggest generic separation, but we

have every intermediate condition. Finally this internal ridge may develop into a conic cusp, as in the *C. cuspidatus* (Fig. 9 *e*).

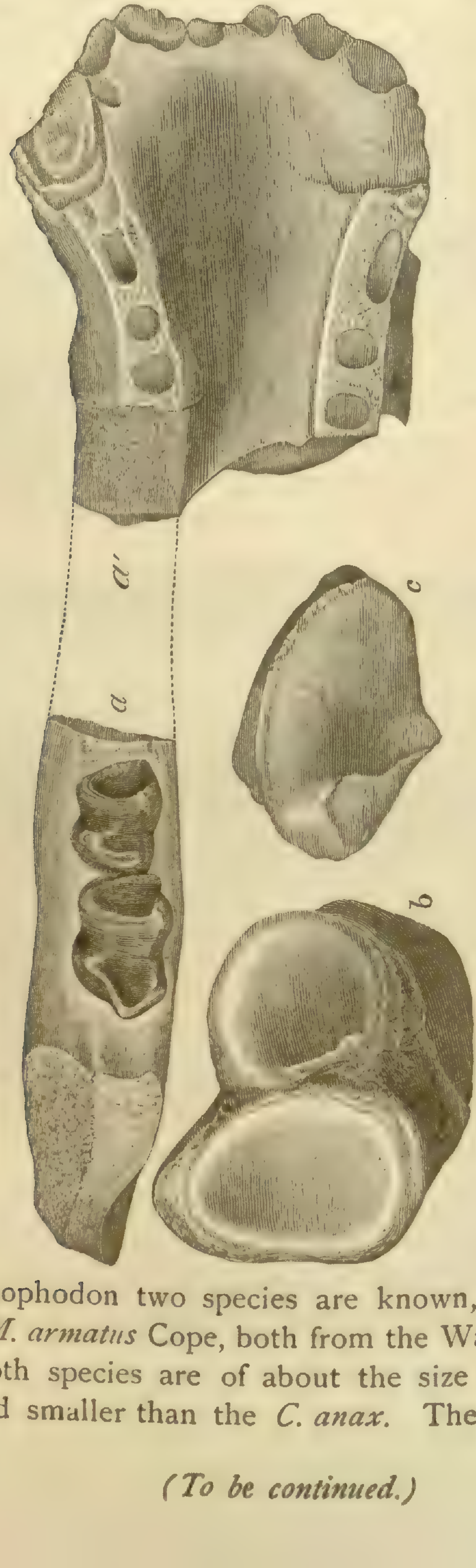

FIG. 23.—*Coryphodon anax* Cope, bones, two-fifths nat. size; individual represented in Fig. 9 *b*. From the Wasatch bed of Wyoming. Figs. *a a'*, mandible, less right ramus, viewed from above. Fig. *b*, head of tibia; *c*, distal extremity of tibia, end views. Original, from Report U. S. Geol. Survey Terrs., Vol. III, F. V. Hayden.

Of Metalophodon two species are known, the *M. testis* (Fig. 16 *b*) and *M. armatus* Cope, both from the Wasatch beds of Wyoming. Both species are of about the size of the *Coryphodon latidens*, and smaller than the *C. anax*. The skeletons are unknown.

(To be continued.)

THE RELATION OF COLOR TO FLAVOR IN FRUITS AND VEGETABLES.

BY EMMETT S. GOFF.

DURING the summer of 1882 I was struck by the coincidence that in several of our fruits and vegetables a white or light colored flesh is accompanied by a milder and more delicate flavor than exists in other varieties of the same fruit or vegetables having a dark colored flesh. Thus the white varieties of onion are milder in flavor than the red ones; the white currants possess less acidity than the red ones, and these in turn have less pungency than the black varieties; the white and yellow tomatoes are sweeter than the red ones; the white and yellow raspberries are more delicate in flavor than the red ones, and these in turn have a less strongly marked flavor than the black varieties. The familiar custom of blanching celery, endive, sea-kale, the cos lettuce and other plants to give them a more delicate flavor, was called to mind, and the fact that the inner leaves of the cabbage head which are white and decidedly more delicate in flavor than the outer green leaves; also that potato tubers "sun burned" through exposure to the light have a very strong and bitter taste. These and other instances came to mind, until I was led to ask whether there may not be a law of relation between the color and flavor in fruits and vegetables.

Every fruit and vegetable has a standard of quality peculiar to itself. This is based upon the natural qualities that make the fruit or vegetable desirable to man. Thus in most fruits quality is based upon delicacy and richness of flavor, with a certain degree of tenderness in the flesh. In many salads it is based upon crispness, tenderness and mildness in flavor; in a few, as the cress, it is based upon pungency. In some vegetables, as the potato and squash, quality depends upon the dryness and farinaceous properties of the flesh, combined with a delicate, characteristic flavor.

In the amelioration of fruits and vegetables, it is the constant aim of the horticulturist to intensify, so far as possible, the desirable qualities and to eliminate the undesirable ones. It is evident, therefore, that if it can be shown that the color of the flesh has a direct relation to its flavor and tenderness, we have a valuable index in the work of selection. If by whitening the flesh

of a fruit, through selection, we can eliminate acid and solidity, or if by darkening the flesh of another fruit, already too tender and insipid, in the same way, we can heighten its characteristic flavor, and increase its firmness, we have gained a new faculty in the work of making the products of nature subservient to our wants.

The hypothesis was therefore assumed, that in a white flesh, in fruits and vegetables, we escape solidity, and a strongly marked characteristic flavor, with a gain, or at least without a loss, of sweetness. This hypothesis was applied to the fruits and vegetables of which I have been able to find complete descriptions. The results of my researches will be given further on.

If the law exists which my hypothesis assumes, it is evident that the processes of selection have operated more or less to obliterate the marks by which it may be traced. Seedlings or sports yielding fruits having a very harsh or acid flavor have been rejected, whatever the color of their flesh. On the contrary, deep colored samples possessing a pleasant flavor, though exceptions to the law, have been preserved. Thus in many cases we are compelled to trace out the law with but half of the evidence. For example, the blood clingstone peach, which is said by Mr. Downing to have flesh "very red, like that of the beet," is pronounced "not fit for eating." Red fleshed peaches are very rarely mentioned in our fruit books. Possibly the reason why so few red fleshed varieties have been preserved is, that their flavor and firmness were such as to make them undesirable.

We may fairly assume that palatability has been a leading principle in selection, and that the color of flesh has had influence only in a few cases where appearance is of some importance. In the currant, the principal use of which is in the manufacture of jelly, the red color is preferable, because, as every one knows, the rich crimson color of jelly made from red currants is more attractive than the pale color of that made from the white currant, though it is equally well known the latter has decidedly the milder flavor. So in the beet and carrot, the rich colors of the deep red varieties of the one, and orange sorts of the other, are more desirable for the table than the paleness of the milder white varieties; and further, as there is no acid in these roots to overcome in their amelioration, their agreeable characteristic flavors are more developed in the deeper fleshed varieties. In the apple,

on the other hand, in which, as I think we may fairly assume, the factor which it was most necessary to eliminate in its amelioration is a harsh acid and an over-firmness, the majority of the varieties are white fleshed. So in the pear, we may assume that toughness and astringency were the qualities to be overcome, hence in this fruit we have mainly white fleshed varieties. In the plum and peach, however, in which the acid element is not very prominent, and which possess very little solidity by nature, we obtain higher characteristic flavors in the varieties having yellow or orange flesh.

Since adopting my hypothesis I have noted down such statements as I have chanced to find in horticultural reading, as bearing directly upon this subject. The extracts here recorded from several different authors seem to recognize the law as applying to special cases, but I have nowhere found evidence that any one has conceived it to be of general application.

In speaking of the leaf, or chard, beet, M. Henri Vilmorin says, in "Les Plantes Potagères," p. 422: "It seems that in all the leaf beets the white color of the leaves accompanies a sweet taste, while a deep green color is indicative of a strong and bitter taste."

In speaking of the turnip the same author recognizes a popular prejudice that white fleshed turnips are milder than those having yellow flesh, and which he is disposed to contradict. With all deference to this great horticulturist, I will say that the result of my own investigations, the detail of which I shall give further on, is confirmatory to the prejudice that he declares poorly founded. He says in the work just cited, p. 362: "It is certainly wrong that in Paris the yellow fleshed turnips should be less esteemed than others. It is here considered that the yellow color is accompanied with a strong and bitter taste, which is far from correct, for we find among the yellow turnips varieties possessing very tender flesh and of very delicate flavor, as well as in the white varieties." It will be observed that this statement does not contradict the existence of a greater proportionate number of mild flavored turnips among those that have white flesh.

Mr. Fearing Burr, Jr., says of red cabbages, in "Garden Vegetables," p. 142: "When cooked they are considered less mild and tender than the common varieties."

Regarding the comparative tenderness and delicacy of blanched

and green asparagus stems, Mr. Robinson, in his "Parks and Gardens of Paris," p. 472, quotes the opinion of a French epicure as follows: "In certain localities they do not yet value the distinction between blanched and green asparagus, and occasionally prefer the latter. That is an error very prejudicial to the consumer's interests. Properly blanched asparagus is infinitely more tender and delicate. All asparagus cut when it is green is not fit to be eaten in the ordinary way, but may be used, cut up small, as an accompaniment to other dishes. To serve up green asparagus is to dishonor the table. In the markets of Paris the green asparagus is worth one franc a bunch, when the blanched is worth three francs."

It has often been a question to my mind why the white beet is almost exclusively used in the manufacture of sugar. I had supposed that the difficulty of eliminating the color from the juice of the red beet to be the probable reason why the latter is not used for this purpose. I have been able to find very little bearing upon this subject, but that little indicates that the principal reason is that the white beet contains a larger percentage of sugar. Thus I find in Morton's "Cyclopædia of Agriculture," Vol. II, p. 925: "Formerly the field beet, with rose colored skin, and presenting, on being cut, alternate layers or zones of a white and a red color, was much more extensively grown in Germany and France for the purpose of sugar making than it is at present. Preference is now given to the White Silesian beet, introduced into France by Mathieu de Dombasle. The latter gives a larger percentage of sugar and contains less water, saline matters and nitrogenous substances than the former." According to M. Vilmorin, all the beets now used in France for the manufacture of sugar have been derived from the White Silesian variety.

In this connection I quote a partial analysis of three varieties of beet from the Transactions of the New York State Agricultural Society, 1852, p. 330. It notes the per cent of coloring matter and of the sugar and extract in each:

Variety.	*Per cent of Coloring Matter.*	*Per cent of Sugar and Extract.*
Turnip beet	.038	43.039
Long blood	.0158	55.327
White sugar		60.023

We may infer from this that the per cent of sugar in these

samples of beet increased as the per cent of coloring matter decreased.

In speaking of the leek, Mr. Wm. N. White says, in "Gardening for the South," p. 241: "The whole plant is much used in soups and stews, but the most delicate part is the blanched stems."

Mr. Charles Downing, in his admirable "Fruits and Fruit Trees of America," p. 629, says of the yellow fleshed peaches as grown under European climates, that they "require our hot summers to bring out their flavor. In a cold climate the acid is always prevalent." From the connection it is evident, as the reader may observe, that this is true especially of peaches having yellow, rather than "pale" flesh.

In speaking of the edible podded or sugar pea, the author of "Les Plantes Potagères" says (p. 423): "The seed of purple-flowered peas is always more or less colored or spotted with brown; it assumes a somewhat disagreeable grayish color when cooked, and has besides a rather strong and bitter taste."

In speaking of carrots the same author says, in "Le Bon Jardinier," 1882, Part 1, p. 437: "The red carrots have in general a more pungent taste than the yellow and white;" and again, on the same page, "the white carrots are esteemed for their sweetness."

Mr. Burr says of the Long White carrot: "Flesh white, and generally considered sweeter than that of the colored varieties."

In speaking of the mushroom, the author of "Les Plantes Potagères" says, on p. 82: "It seems to us, after several comparative trials, that the white variety is preferable to the others as a vegetable. The light-colored (blonde) variety appears to us less tender and perfumed [than the white], the gray has, on the contrary, a stronger taste."

Mr. Burr, in "Field and Garden Vegetables of America," p. 284, quotes the following in relation to the sea-kale: "These shoots form the edible portion, and being blanched under ground they are tender and white, and from six to eight inches long. The shoots should be cut as soon as they reach the surface, because if the shoot comes through, the top gets purple, and the plants become strong flavored."

The same author pronounces the blood red onion, in which not only the outer coats but the inner ones, except those most central, are stained red, "one of the strongest flavored of all varieties."

The large red is said to have "purplish white" flesh, and to be "stronger flavored than that of the yellow or earlier red varieties."

But of more value than all the testimony of impressions and quotations, is the result of a careful investigation of existing varieties. Do the varieties of fruits and vegetables, as described by unprejudiced horticulturists, when put to the test of figures, show clearly that mildness and sweetness accompany light colored flesh to a greater extent than dark colored? This is the test question. In the tables that follow, the testimony on the fruits is gathered mainly from Downing's "Fruits and Fruit Trees of America," and that on the vegetables from Burr's "Field and Garden Vegetables of America."

I have gathered in the table only such terms as express a definite quality, and which apply to my present purpose. Many terms are used, such as "delicious," "pleasant," "agreeable," "good," etc., which convey nothing specific in regard to flavor. Many shades of color are also delineated which are intermediate between the extremes, such as "greenish white," "yellowish white," "greenish yellow," etc. These I have not used, as the number of varieties to which they are applied is, in most cases, small, and they do not apply directly to the present purpose. Sometimes, for the purpose of simplifying the table and increasing the number of varieties, I have united two or more terms, which mean very nearly the same thing, into one. Thus the "deep yellow" as applied to the peach in the table, includes those described as "orange," "deep orange," "orange yellow," "rich yellow," etc.

In the table of vegetables the numbers are too small to make the testimony of much value, though so far as it goes the evidence is decidedly confirmatory to the hypothesis:

	Color of Flesh.	Number of Varieties.	Per cent "Sweet."	Per cent "Mild."	Per cent "Delicate."	Per cent "Tender."	Per cent "Melting."	Per cent "Juicy."	Per cent "Crisp."	Per cent "Firm."	Per cent "Rich."	Per cent "High flavored"	Per cent "Sub acid."	Per cent "Acid."
Apple	White	156	22	17	4	73	2	60	13	7	24	7	43	3
	Whitish	40	25	25	5	77	2	65	20	7½	20	0	55	5
	Yellowish	92	20	22	0	55	4	59	30	14	44	3	52	6
	Yellow	74	18	9	1	42	0	45	27	15	60	7	42	4
Pear	White	198	57	..	6	45	63	69	.	....	23	25	35	.
	Whitish	51	49	..	0	0	82	78	..	....	35	2	6	..
	Yellowish	16	38	..	0	0	81	63	..	....	44	0	6	.
	Yellow	3	33	..	0	0	33	100	..	....	33	33	0	..
Peach	White	21	33	..	5	..	71	81	..	5	43	24	0 sub-acid and acid	
	Yellowish	22	60	..	0	..	14	45	..	14	45	9	14	
	Yellow	73	52	..	0	..	18	52	..	7	33	4	8	
	Deep yellow	26	23	..	0	..	15	42	..	8	27	4	15	

	Color of Flesh.	Number of Varieties.	Per cent "sweet," "sugary."	Per cent "mild."	Per cent "delicate."	Per cent "well flavored."	Per cent "farinaceous," "mealy."	Per cent "dry."	Per cent "tender."	Per cent "fine grained."	Per cent "coarse."	Per cent "watery."	Per cent "strong."	Per cent "solid."
Potato	White	12	....	8	..	[1] 58	58	[2] 75	..	..	0	0	0	..
	Yellow	7	....	0	..	0	14	28	..	..	14	14	28	..
Turnip	White	13	100	16	..	..	..	..	50	53	..	..	..	38
	Yellow	8	75	0	..	..	..	..	46	25	..	..	..	25
Ruta baga	White	4	[3] 100	50	25	..	..	..	..	25	..	..	..	50
	Yellow	6	50	0	0	..	..	..	..	17	..	..	..	83

It will be observed that in every case where the terms "sweet," "mild," "delicate," "tender" and "melting" are used, the per-

[1] One was called "very well flavored."

[2] Of these one-third or twenty-five per cent were called "very dry."

[3] Two of these, or fifty per cent, were called "very sweet."

centage is highest in the white fleshed varieties. It appears also that the per cent of acidity is greater in varieties having dark colored flesh. In the pear the percentage called "sub-acid" is decidedly greatest in the white fleshed varieties. This may at first seem contradictory to my hypothesis. It should not be forgotten, however, that in the apple and pear a mild acidity greatly improves the flavor, and hence this apparent exception is possibly the result of selection.

In the plum no varieties are said to have white flesh. I find, however, that in five varieties in which the flesh is called "amber color," and three called "pale green," none are called acid; while in fifty-nine varieties called "yellow," five have some acid, in thirty-three called "greenish yellow," three are called acid, in twenty called "greenish," five are called acid, and in nine called "greenish yellow," three are called acid.

In the other fruits and vegetables I have not found sufficiently accurate descriptions to permit me to judge whether the hypothesis holds or not.

If further investigation should discover sufficient evidence in this direction to establish a law, this law will have an important practical application in the amelioration of fruits and vegetables.

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GROWTH, ITS CONDITIONS AND VARIATIONS.

BY CHARLES MORRIS.

(Continued from page 1101, November number.)

FAR back in the history of life we reach a period in which crustaceans and mollusks seem to have been the lords of the earth. During the greater part of the Palæozoic age the ocean invertebrates were dominant, they grew to great size, developed rapidly in functional ability, and swept the seas of their stores of food. We know little of the struggle which then took place between the various invertebrate sub-kingdoms, or of their probably successive rise to supremacy. Nor can we trace the struggle between the members of each sub-kingdom. So far as evidence goes the cephalopods would seem to have been contemporaneous in origin with humbler representatives of their race and of other races. But this is doubtless an illusion produced by an undue crowding together of the geological tablets.

This invertebrate era was succeeded by the earliest stage of

the vertebrate. The Palæozoic fishes appeared. At first they must have been inferior in size, weapons and food-getting power to their invertebrate rivals, who so long had ruled the sea. But their superiority of organization quickly told. They came into competition with their former superiors, and soon progressed beyond them, gaining massive armor of defence and strong reptilian teeth for attack. The empire of the seas had passed into new hands. These great ganoid and dipnoid fishes increased in size and strength, the invertebrate wave sank before them, and the lordship of the ocean became their own. The result was the same that has appeared in all such cases. They not only grew great in bulk, from the abundance of their food supply, but they varied with the greatest rapidity in specific character, assuming every variety of adaptation to their variety of food. This rapid specific variation of each type of life immediately after gaining the supremacy over preceding dominant types, is a fact which may be traced throughout the geological age, and indicates that variation in form and habits, while slow under ordinary conditions, may be extremely rapid under such specially favoring circumstances.[1]

These early dominant fish, while superior in power to all preceding animals, were inferior to those that succeeded them in the fact that they trusted for defence to massive armor instead of to speed. In the whole history of life trust to armor has been an inferior characteristic, the armored animals have tended to grow more sluggish, and in most cases to assume a sedentary life, while all steps of higher development have been attained by the less weighted and swifter moving animals. Such is the story of ocean life. As we enter the Mesozoic age unarmored reptiles succeed to the armored ganoids and quickly take from them the empire of the seas. The duplex characteristics of the Palæozoic fishes seem to divide, developing in one direction into the more efficient reptiles, and in the other into the teleostean fishes, which are well adapted to obtain food from the humbler life of the sea. The only continuous representative of the earlier dominant fishes is the shark, which had cast off its excess weight and thus became able to contest the field with the swimming reptiles, and even to survive them. But the immense size attained by these

[1] For the details of this hypothesis see paper by Alpheus Hyatt, *Science*, Nos. 52 and 53.

reptiles, and their rapid variation in specific character, indicate their superiority over all the remaining ocean life of their period, the abundant food which they obtained with little effort, and the variety in organization and methods of escape of this food, which necessitated accordant variations in its foes.

While these revolutions were taking place in the empire of the seas, life had invaded the land. Insects were the first animal inhabitants of the land, so far as evidence goes. They gained no extreme size, perhaps through a paucity of food supply and organic inefficiency. Yet land articulates seem to have rapidly increased in variety, since spiders, scorpions and myriapods appear almost contemporaneously with insects. At the same period, or shortly afterwards, ocean vertebrates invaded the land. The character of their invasion singularly resembles that of the articulates. The latter were obviously derived from water articulates, since the first known forms belong to those families which pass their larval period in the water. In like manner the earliest land vertebrates were batrachians, which in their larval state are water animals. These creatures seem to have found a free field and abundant food, and to have multiplied and varied with great rapidity, while some of them attained great bulk despite their imperfect organization. Cope gives a list of thirty-nine genera and about a hundred species of Carboniferous batrachians, which indicates that the full degree of specific variation was very great. In fact they seem to have had the world of the land to themselves, with nothing but the imperfection of their organization to hinder their obtaining superabundant food with little exertion, and thus growing to immense size.

This age of batrachian dominance was succeeded by one in which the wave of batrachian life declined, while huge land animals took their place on the throne of the empire of life. The batrachians were unfitted to compete with reptiles in the struggle for food, and were obliged to content themselves with lesser supplies, so that they quickly diminished in size before the onset of their strong competitors. Very probably personal assault from these new-comers, as they grew stronger and able to cope with the batrachians, hastened the decline of the latter, and drove them down into the humbler fields of life.

And now came a new life era. The land reptiles increased in number and variety with the seeming suddenness of all preceding

dominant forms, and grew in many instances to enormous bulk, far exceeding anything previously known among the inhabitants of the land. Step by step the animal world was learning the art of food taking. The lesson was slowly learned. The two energies of escape and pursuit kept pace in development, each forcing the other upwards. The continued effort at escape or defence must have yielded steadily greater efficiency and variety. This in its turn rendered necessary the development of new and more efficient weapons and methods of assault. Thus has life been pushed ever upward, the Carnivora forcing their living food to superior development, and the food animals exerting a like influence upon their carnivorous foes throughout the whole long reign of earthly life.

But as in all preceding eras of life, during this age of reptiles their destined successors to dominion were slowly developing, in lowly forms, far below the huge reptilian monarchs. True birds gradually developed, and the flying reptiles disappeared before them. The feather proved superior to the membrane as a flying organ, and in the competition for food which succeeded, the membrane-winged creatures vanished. At a later period other membrane flyers, of mammalian organization, came into competition with the feathered tribe. But they have failed to dispossess them. The bats have been restricted to a nocturnal life, and the birds still hold the diurnal empire of the air.

Such was not the case with the mammalian occupants of the other two fields of life, the land and the sea. Before their onset the wave of reptilian life rapidly sunk, and that of mammalian life as rapidly rose. This advance of the Mammalia to supremacy seems to have been a slow one, and was probably hotly contested by the strongly-armed, swift-moving and huge-sized reptiles. But as in all cases, a superior organization eventually won the battle. The earliest mammals were of the lowly-organized marsupial type. They seem to have been incompetent to cope with the powerful and vigorous reptiles, and after their first appearance, vanish from sight throughout the long period of the Cretaceous era. They probably continued too insignificant to leave any strongly declared marks of their existence in the rocks.

Just how or when the placental mammals appeared, we are ignorant. But their unquestionable superiority to the reptiles in

organization quickly made itself manifest. The reptiles sunk and the mammals rose to the supremacy with such seeming suddenness that it appears almost the work of miracle. Of the hard battle for empire which must have taken place, not a trace remains. We step from the Cretaceous to the Eocene era, and at once we pass from a world ruled by huge reptiles into one controlled by equally huge mammals. The wave of reptilian life rapidly declined, while that of mammalian life broke over it. The former imperial rulers of land and sea sunk into lowly creeping and lurking forms, while the new lords of life grew into swimming and stalking monsters of unquestioned superiority.

It is not probable that this change took place as the consequence of an actual battle between reptiles and mammals. More likely it resulted from a sharp competition for food, in which the mammals gained the victory, the more specialized great reptiles dying out through starvation, while the generalized forms decreased rapidly in bulk and gained new habits.

In regard to this superiority of mammals over reptiles one of its most important features was the hot-blooded organization of the former as compared with the cold-blooded condition of the latter. The result of this condition was to make the reptiles essentially tropical in habitat. Such forms as ventured into colder regions must have hibernated in the winter, and thus could not well have attained any extreme bulk. Hibernation was not necessary to mammals. This fact at once gave them a superiority in colder climates, in which they could develop unopposed, and from which they could descend to the tropics in bulky and vigorous forms to compete with their reptilian predecessors for the food supply.

As for the oceanic mammals, it is not impossible that they also gained their early development in colder regions, which many of them continue to inhabit, and thence pressed southward to compete with the great ocean reptiles. The huge toothed whales of the early mammalian period, typified by the gigantic *Zeuglodon*, probably were particularly well adapted to obtain food, and may have rapidly swept away the food supply of their predecessors. In this connection there is one point of the greatest importance, to which we have as yet made no allusion, though it doubtless was strongly influential in causing sudden replacements of old by new forms of life. If the competition between old and new types

was less one of personal battle than of success in obtaining food from a common source, then it does not appear at first sight evident why the different dominant types should not have overlapped, the great reptiles, for instance, continuing into the Eocene instead of completely abandoning the field to the mammals.

There is a probable cause of this, to which no attention has hitherto been called, yet which may have been amply sufficient in all such cases. Thus the great carnivorous oceanic reptiles pursued prey which they must have found continually greater difficulty in capturing. The easily taken forms either vanished or changed in organization and habits, growing smaller, swifter, and more wary. They also became continually better adapted to the modes of attack of their foes, so that the difficulty of the latter in obtaining sufficient food for their needs must have steadily increased, and a retrograde movement in size and numbers have arisen. Under such circumstances a new-comer, which had attained size and strength in another region, must have possessed a peculiar advantage. The swimming food had learned the art of self defence or escape from its older foes, but lay helpless before this new foe, to whose mode of attack it was not accustomed. Such a new-comer would therefore be able to make fierce havoc in the ranks of the food animals, and rapidly cut down the harvest. It would tend to a rapid increase in bulk and strength, while its older competitors must shrink in size or perish, starved out of existence. Even when otherwise equal in organization the new-comer would have an immense advantage in the lack of adaptation of the food to its weapons and methods of assault. It is perhaps largely due to this cause that sudden successions in reptilian forms, and in the dominant forms of other types, took place. New forms came from distant regions and robbed the indigenous forms of the bulk of the food. But when to this advantage was added that of a superior organization, as of reptiles over batrachians and of mammals over reptiles, the earlier forms would be supplanted yet more rapidly and completely, and changes in the dominant forms of great suddenness might take place.

To this cause of the numerous apparently sudden replacements of old forms by newer, unrelated forms in geological times, may be added another, which refers to a similar rapid replacement of related forms. The case so far described is that in which a dom-

inant form of animals was replaced by another form of different type which had been slowly growing up beneath it, or more probably had migrated from another locality into one whose food animals were helpless before its assault. But there is another case of extreme importance, that of the apparently sudden replacement of one species by another of the same genus or family, usually of superior organization, with no trace of steps of succession from the one form to the other. This absence of link-forms between closely related species is one of the most marked characteristics of palæontological evidence, and seems to strongly hint at specific succession by leaps instead of by minute steps. Yet the question of food supply yields one argument in favor of the latter which may be here given.

A replacement of one species by another indicates that the second is in some way better adapted to the existing conditions of nature, or to new ones which have arisen. In other words, it is suited to obtain more food with equal exertion, or equal food with less exertion. But the competition which arises is stronger and closer between the offspring and the parental form than between diverse forms. The two related forms are adapted to the same kinds of food, and are closely similar in weapons and habits. Hence of all forms of animal life the one which is put most at disadvantage by the food taking ability of a new form is its parental form. Other tribes of different organization and habits come less into competition with it, or at less disadvantage. If adapted to an entirely different food there is no competition.

Thus two important results are likely to spring from the evolution of a new animal form, specially well adapted to the food conditions of surrounding nature, or possessed of a variety of weapon or habit of assault to which the food has gained no defensive adaptation. One of these results must be the rapid disappearance of the parental form, which will be starved out of existence. And if there be several successive link-forms, each must rapidly yield to its successor. Thus if a considerable or rapid change of natural conditions necessitates a similar rapid succession of specific variations in some animal tribe, not only the original form would vanish, but the link forms would quickly disappear. The new dominant form would tread down its steps of advancement, and the intermediate forms, having a comparatively short term of existence, and giving rise to comparatively few in-

dividuals, would be very unlikely to leave a geological record of their existence. This perhaps is one important cause of that marked absence of link-forms between related species which has given rise to so much controversy.

The effect of this influence upon animals of different type, but subsisting on similar food, would probably be of a different character. While acting to crowd out older forms it might also instigate specific variation, and the evolution of new organs and habits. Thus progress in any one type might powerfully tend to cause progress in other types, and new species evolve simultaneously in several unrelated types, through the action of a single initial force.

As to the succession of huge Mammalia in the Tertiary age, little need be said beyond the considerations already taken. One important fact appears, that the greater land Mammalia were Herbivora, a fact in opposition to that which appears in the case of air and ocean animals, in which elements the Carnivora have always held the supremacy in size. The reason for this we have considered in the case of the birds. As for the ocean animals it naturally arises from the fact that in the ocean animal food is far more abundant and nutritious than vegetable. On the land the opposite conditions rule. Vegetable food is more abundant, while animal food can only be obtained with greater exertion than is required in the water. Hence we find the land Herbivora steadily tending to exceed the Carnivora in size. This is not the case with those timid Herbivora which seek safety in flight, and thus exhaust tissue by great muscular effort. But as soon as a grass or leaf-eating animal grew strong and bold enough to resist and fight off carnivorous foes, the diminished exertion required and the greater time for nutrition, enabled it to increase in size and to quickly grow too powerful to dread the strongest Carnivora.

This result we find occasionally even among the ordinarily timid deer, as in their extinct relative, the gigantic Sivatherium. Of the other huge forms it will suffice to mention the mighty stalking Dinosauria of the reptilian age, whose biped attitude must have aided them to a superabundant supply of leaf food; and the elephantoid mammalian type whose superior organization enabled them to persistently survive and to evolve successively better adapted forms, while other types swelled into hugeness shrank again and disappeared beside them.

We cannot undertake here to consider the various huge creatures which successively appeared and vanished, with the probable cause of their success. It is simply our purpose to generally illustrate the principles of growth already reviewed. A brief reference to the vegetable kingdom, however, is here of some importance. In this kingdom nutriment is not consumed in producing muscular, nervous or temperature vigor, and reproductive energy alone competes with growth vigor. In vegetables, as in animals, those that employ most nutriment in reproduction attain the least size. The trees which bear juicy fruits, and which thus lay up a large stock of protoplasm for the use of their offspring, are smaller and shorter lived than the nut-bearing, and these again than the seed-bearing.

Also in vegetables as in animals the size is greatly affected by the degree of efficiency in food-taking, and by the character of the embryological development. The spore-bearing plants, the ferns, mosses, &c., yield cases of larval birth. The young needs to pass through a phase of metamorphosis which consumes much of its initial growth energy. Other facts in this connection are the following: Plants which are prevented from seeding are longer lived and grow to greater bulk. On the contrary, those which flower early die young, and the cultivation of fruit trees for early and extreme bearing shortens their lives.

Again, plants of imperfect organization often attain great size in situations of high temperature, abundant nutrition and decreased reproduction. Such is the case with the tree ferns of the tropics, and such was the case with the many huge plant forms of low organization in the Carboniferous age of geology. In this respect plants present phenomena somewhat parallel with those of animal life. With the appearance of the exogens began a retreat of the endogens and the lower forms. While palms, ferns and other low forms have been able to hold their own in the tropics, the exogenous trees have gained the supremacy in colder climates. In these regions the competition for food has been decidedly in favor of the exogens, the endogens have sunk into the lowly grasses, and the ferns into feeble inmates of damp situations. Even the more hardy conifers have been driven back before the march of the exogens, and have retreated to the marshes and the cold and partly barren mountain sides, where the character of their organization seems to give them an advan-

tage over their rivals. The nutritive superiority of exogens over endogens and ferns probably arises from their habit of laying up each year an excess stock of nutriment for employment in the early periods of the succeeding year. This relieves them from the necessity of bearing their heavy covering of leaves throughout the storms of winter, and gives them a decided advantage in cold climates over evergreen plants. As for the conifers, they have reduced their leaves to needles, probably for protection against the destructive action of winter storms.

We have one other matter to consider in conclusion. One of the most striking phenomena of palæontological history is the disappearance of most of the great Herbivora and Carnivora with the advent of the Quaternary epoch. Such has not been the case in the air and the water. The whale and the condor have probably never been surpassed in size in their respective fields. Significantly this disappearance on land is closely related to the coming of man. It might appear as if man, with his superior weapons and powers, had been the moving force in this phenomenon. Yet such can hardly have been the case. Man did not come into destructive competition for food with these larger animals, and not at all with the grass and leaf-eating tribes. He may have slaughtered many, both of the Herbivora and the Carnivora, yet he could hardly, in his early days, have greatly diminished their numbers in this manner. For the changes which took place other causes must be sought, and probably the most vigorous of these was the radical changes in climate which took place at this period. Many of the greater animals, incited perhaps by the existence of partly tropical conditions in the temperate regions, had made their way far to the north. On these came down the chill of the glacial epoch, whose influence must have made itself felt even throughout the tropics, and which caused a general change of condition that must have been greatly destructive of animal life, and particularly of the bulkier and more sluggish forms.

After the icy period passed and genial conditions again appeared, the land animals were found to have markedly decreased in bulk. The present elephant succeeded to the gigantic mastodons and mammoths as the greatest of the land animal kind. And with it man had fully disseminated himself over the earth, a new dominant form whose advent put a final and decided check

to the development of any new herbivorous monster. Man needs the earth for himself; he demands the bulk of the food; and the older dominant forms of the lower kingdom of animals are steadily declining and disappearing before his destructive vigor and successful food competition.

Some remarks in regard to the size of man are pertinent in conclusion. The human type, if derived from the Quadrumana, has, like several other animal tribes whose fossil progenitors have recently been discovered, steadily increased in size. The lower Quadrumana are arboreal in habit, and are necessarily restricted in size by the exigencies of their active life. Those which have left the trees for the earth have diverged in two directions, towards the essentially quadruped baboon, and the nearly biped anthropomorphic ape. To the latter the human biped is most nearly related. But the superior organization and powers of man have not resulted in an increase in bulk over the great apes. There has been rather a diminution. And this may have arisen from the great muscular activity and mental energy of man, necessitated in his migratory outspreading over the earth, and his incessant conflict with the lower animals, to which the tropical forest life of the modern great apes makes no demand.

If we consider man in his civilized state no lack of activity appears. The muscular is merely replaced in great measure by active mental energy. Food has grown abundant, but is not superabundant with the great mass of the people of any nation. The share of food obtained by the active farmer, for instance, is much less than that obtained by the sluggish ox in his field. Thus the present average size of man is doubtless partly governed by the average quantity of food which each man can obtain. There is some reason to believe that man to-day is of greater bulk than was the man of the middle ages. The food supply for each man is certainly greater than then. It might be argued that by a decrease in the number of men, under present conditions, an increase in the food supply of each and, therefore, in the average size might be produced, yet any such variation can only take place with extreme slowness. As man now exists his size is in harmonious relation with the conditions of his existence, and cannot be rapidly departed from. In addition to the growth-restraining energies of muscular and mental activity, the reproductive capacity is such that there is a constant tendency to crowd

the field of life and diminish the average supply of food. This is, as yet, obviated by the augmentation of the food supply through human labor, which has, for a long period, caused a steadily increasing ratio of food to consumers. Thus the increase both of leisure and of food supply of civilized man favors an increased growth vigor. If in the future of civilization human fecundity should decrease, as it shows some indications of doing, the size and length of life of man might markedly increase, and the development of the individual gain upon the reproduction of the race.

Hereditary influences act strongly to prevent deviation from any established standard. Yet the leveling effects of heredity are constantly opposed by energies of variation. These seem to be of two kinds, variation by the preservation of minute increments, and by considerable leaps of change. The Darwinian theory of specific variation trusts solely to the former, yet the opposing facts it has to overcome are so many and vigorous, and the palæontological evidence is so strongly in favor of considerable variations, that the idea of leaps from species to species is steadily gaining strength.

The same considerations hold in regard to size variation. It may arise from minute changes, or from the preservation of considerable leaps. Slight variations in size are universal, but leaps to giant or dwarf individuals are not uncommon. With the lower animals it is quite possible that these great variations in size, when in harmony with suddenly changed surrounding conditions, may have been occasionally hereditarily preserved, and rapid growth or diminution in bulk of a tribe of animals have taken place. In man such abnormal variations can scarcely become dominant. Human agency has so succeeded in equalizing the food supply, and in restraining the tendency of outer nature to variation, that conditions vigorously aiding the preservation of a giant or dwarf race are unlikely to arise. The mental force of prejudice is also more strongly active against such a change in man than in the lower animals. Thus human variation in size is more likely to be in accordance with the Darwinian law, of preservation of minute increments of change, in correlation with slowly varying conditions, alike in the food supply, the exertion necessary to obtain it, and the reproductive energy. Giant and dwarf races at present exist in certain regions of the earth, probably produced

in this slow manner, but civilized man everywhere tends to a close conformity in size, as he also does in conditions of existence. Thus any future change in the average size of man must be of very slow evolution. Its direction will probably be towards greater bulk.

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PRELIMINARY NOTE ON SOME FOSSIL FISHES RECENTLY DISCOVERED IN THE SILURIAN ROCKS OF NORTH AMERICA.

BY PROFESSOR E. W. CLAYPOLE.

I.

THE lowest Old Red Sandstone of Scotland, the argillaceous slates of Cornwall and the calcareo-argillaceous beds of Ludlow in England, have furnished the most ancient fossils yet published which can be attributed to the class of fish. The first and second of these horizons are included in the Devonian system, the third, which is also the most ancient, forms the upper part of the Silurian.

Except two species of Onchus (*O. murchisoni* and *O. tenuistriatus*) all these fossils are referred to the abnormal family of Cephalaspids—a family so abnormal that some zoölogists have seriously doubted if its members were really entitled to the name of fishes. But evidence recently obtained has, in the opinion of those who have specially studied them, Professors Huxley and Lankester, satisfactorily settled the question in their favor, and they are now, with general consent, retained among the vertebrates, of which they form the most ancient type hitherto recognized.

Fossil fish have been reported from rocks called Silurian in Bohemia and in Russia, but the genera and species present an aspect so decidedly Devonian, judging by the English strata, that it is not easy to correlate the two. Asterolepis, Gompholepis, Coccosteus and Ctenacanthus can scarcely be paralleled with the more primitive types of the English Ludlow above alluded to.

No species of fish has yet been published from the Silurian rocks of America, or even from the Lowest Devonian. The most ancient fossils of this class which the western continent has yielded have been found in the Corniferous limestone of Ohio and the beds at Campbellton near Gaspé in Canada. Of these the latter is probably rather the older of the two, as it contains

Cephalaspis, which has not yet been reported from the former locality. The two species known are: *Cephalaspis dawsoni*, *Cephalaspis campbelltonensis.*

During my recent work on the palæontology of Pennsylvania I found some fossils much resembling the well-known specimens from the "Ludlow beds" of England, which for fifty years have been the oldest known fishes. They were an Onchus and two kinds of shields very close in outward form to the Scaphaspis of Lankester.

The study of these fossils has proved that this resemblance is not merely superficial, and that there unquestionably existed, both in Pennsylvania and in England, similar species of fish which characterized the Upper Silurian era in both continents.

The shield, like that of Scaphaspis, as described and figured by Huxley (*Q. J. G. S.*, Aug., 1858), consists of three layers. The inner layer is thin and homogeneous, having a thickness of about $\frac{1}{240}$ of an inch. On this reposes a cellular layer about $\frac{1}{80}$ of an inch in thickness, the walls of which are composed of the same material. These cells open on the interior surface by round pores which traverse their floor, that is, which pass through the inferior layer of the shield. The cells also communicate by openings in their covering layer with a system of canals lying above them.

The outer layer has a thickness of about $\frac{1}{120}$ of an inch, and is composed of the same material as the two already described. It is traversed from end to end by two systems of vessels of which the lower is immediately above the cellular layer, with which it communicates by the openings above mentioned. The canals of this system have a diameter of about $\frac{1}{240}$ of an inch, and from their sides issue branches almost as large as themselves. These branches communicate with another system of canals (or furrows) a little above them and rather less in size, running parallel with them from end to end of the shield under the superficial striation.

Connected with the former of the two systems of canals, and springing from its upper surface, is a delicate and beautiful thicket of minute branching tubules, becoming continually smaller and smaller until they terminate at the outer surface of the shield. Under the microscope they stand out distinctly in black on the transparent background of the material which composes the lay-

ers and present a beautiful spectacle with an objective of a fourth or a fifth of an inch.

This description coincides in all details of importance with those given by Professor Huxley in his figure of Scaphaspis. But in several minor points of structure there are differences which make it doubtful if the specimens here described can be referred to that genus. The most conspicuous of these is the regularity and parallelism of the vessels in the outer layer, a feature not shown in any already described species of Pteraspid, so far as I have been able to ascertain. This and some other distinctive features have induced me to place them in a new genus under the name of Palæaspis, in which they constitute two species: *Palæaspis americana*; *Palæaspis bitruncata*.

Accepting the usual correlation of the Upper Silurian rocks of Britain and America, according to which the Ludlow rocks are the stratigraphic and palæontologic equivalents of the Lower Helderberg, the lowest bed of the latter, the Water Lime must lie on the horizon of the English Lower Ludlow. The last is the lowest fish-bearing stratum known in Europe, and has thus far yielded only a single specimen. This, the earliest vertebrate fossil hitherto known, is, as Lankester remarks, enormously older than its kindred fossils from the Upper Ludlow, the bone bed of which has yielded numerous specimens both of the same species (*Scaphaspis ludensis*) and of others.

The fossils above mentioned were found in a stratum which, in my report on the geology of Perry county, now in the press, I have named the "Bloomfield sandstone." It lies at the top of the variegated shale or marl, the middle portion of the great mass of the Onondaga. This—the upper part of the fifth group of Rogers in the first survey of Pennsylvania—is about 1500 feet thick and almost barren of fossils. The only species, excepting those here described, with which I have met in the county, is the well-known crustacean, *Leperditia alta*. This shale is divided into three parts:

Lower Helderberg, water lime.

Onondaga....	Gray marl	200 feet.
	Variegated marl	700 "
	Red shale	700 "

The "Bloomfield sandstone" consists of a series of thin red and gray beds separating the variegated from the gray marl. The fossils have not been found generally diffused over the exposure

of the rock in the county but in only a few places. Probably if it were more accessible they would prove to be more abundant. They are seldom in a good state of preservation, but fragments capable of exhibiting the structure are abundant in some places.

From the above facts it may be inferred that the Pennsylvania fossil, Palæaspis, is somewhat older than the unique *Scaphaspis ludensis* of the English Lower Ludlow, and therefore considerably older than the specimens of Scaphaspis and Cyathaspis? that have been found in the Upper Ludlow.

A thousand feet lower down, in the middle of the red shale, I have met with a thin bed full of comminuted fish-scales or shields resembling in many points those of Palæaspis. Their matrix presents some resemblance to coprolites, but their condition is too imperfect to allow of description.

Nor is this quite the whole. Five hundred feet lower still, below beds indisputably of Clinton age, as determined by their fossils, among which are *Calymene clintoni*, *Beyrichia lata*, *Hormoceras vertebratum*, lies the well-known iron sandstone of the Clinton group of Pennsylvania. In this is a thin layer thickly charged with comminuted scales in much better condition than those in the red shale. With these occurs a spine somewhat like those from the Bloomfield sandstone, and which I have named *Onchus clintoni*.

Associated with these are great numbers of small pellets which present all the characters of coprolites, and may be referred almost with certainty to that group of objects, being in great part composed of phosphate of lime.

It is evident that in these fossils we have the most ancient relics of vertebrate life yet known from any part of the world. At the same time, though carrying the existence of fishes down through at least 1500 feet of strata and back through a corresponding lapse of time, it must be added that these fossils do little or nothing to bridge over the chasm existing between the vertebrates and the invertebrates. Odd and aberrant from the type as they are, they cannot logically be excluded from the class of fish, and though we know nothing of their soft parts, it is reasonable to believe they were arranged as in their nearest allies of which we know anything, Cephalaspis and Coccosteus.

Yet on the other hand, though these particular fossils throw no light on the connection between vertebrates and invertebrates, it is an indisputable fact that the whole group to which they be-

long, including Pteraspis, Cyathaspis, Scaphaspis and Palæaspis is marked off by a remarkable peculiarity of structure from every known vertebrate animal. So conspicuous is this character that by its aid we are able to distinguish the smallest fragment of their bony shields from all other bone whatever. Not a trace can be seen in them of the peculiar structure which to the anatomist characterizes true bony tissue. The bone cells (lacunæ) and the tubules (canaliculi) connecting them are totally absent. Nor can the Haversian canals, which are usually present in bone, be discovered. So important is this fact that the unwillingness of some naturalists to admit them among vertebrates was natural and defensible. Nor was this unwillingness overcome until the discovery of a specimen showing a few scales attached to the matrix behind the shield afforded indisputable proof of their ichthyic affinity.

The profound significance of this fact has not yet, it appears to me, been fully appreciated by systematists, nor has the fact itself received the recognition to which it appears to be entitled. Probably the obscurity in which these organisms have been hidden, their imperfection and their local and individual scarcity have contributed to bring about this result. Yet it is hard to avoid the conviction that in this immense anatomical difference there may be concealed at least one stone of the bridge that shall some day span the gulf now separating the vertebrates and invertebrates, and that in this approximation to a simpler structure we may see a link between the highly complex tissue of true bone and that simpler and more homogeneous material of which the hard parts of animals lower in the scale are composed. It can be but one link; others would still be wanting. The relative positions of the hæmal and neural elements would present the same difficulty, and the riddle propounded by these will perhaps be never read, as the soft parts are not likely to be preserved.

In thus carrying down the remains of fish almost to the base of the Upper Silurian rocks, it becomes evident that we must seek in some part of our Cambro-silurian series to find yet earlier forms. It is not likely that these are the first that existed. Lower beds must be searched. Pander's "Conodonts" may yet take their place among vertebrates, and fossils older than they may come to light before we can say we have found "the missing link," if such ever existed—the Ichthyic Archetype.

THE HARP SEAL A PERMANENT RESIDENT IN THE ST. LAWRENCE.

BY C. HART MERRIAM, M.D.

THE harp seal (*Phoca grœnlandica*) is a circumpolar species abounding in the northern seas at certain times of the year and coming south in winter as far as the Grand Banks of the North Atlantic.

It is an off-shore species, living in the open sea or among the ice, and rarely approaches land excepting for the procurement of food under certain special circumstances hereinafter detailed. I am not aware that it ever crawls upon rocky ledges, or even sand bars, as does the harbor seal (*Phoca vitulina*) and several other species.

During the season of bringing forth and caring for its young, which occupies nearly two months (usually from the middle or latter part of February till the middle of April), vast multitudes of harp seals congregate on the ice fields around Jan Mayen island, and on the drifting floes to the north and east of Newfoundland. The fact is also well known that large numbers regularly whelp on the ice in the Gulf of St. Lawrence, but these are supposed to be a branch of the main herd which has passed southward through the Straits of Belleisle, while the main body passed to the eastward of Newfoundland. On this point Mr. J. A. Allen, in his excellent monograph of the Pinnipeds, observes: "Their passage southward along the Labrador coast occurs before the ice forms, and during this journey they are said to 'hug the shore' and freely enter the gulfs and bays. They appear first in small detachments of half a dozen to a score or more individuals; these are soon followed by larger companies, which increase in frequency and numbers; in a few days they form one continuous procession, filling the sea as far as the eye can reach. Floating with the arctic current, their progress is extremely rapid, and in one short week the whole multitude has passed. Arriving at the Straits of Belleisle, the great body is deflected eastward, but many enter the straits and pass round to the southward of Newfoundland; some, however, spend the winter in the Gulf of St. Lawrence, where they bring forth their young on the ice in spring" (pp. 642–643). But neither this author nor any other writer, so far as I am aware, has intimated that the species in question might be found in any part of the St. Lawrence after the

close of the breeding season. In fact, authorities agree that its range, in these waters, is limited to the lower gulf, from Anticosti, the Magdalens, and St. Paul's island, outward; and that it is found here during the winter months only.

In cruising about in the river and gulf during the summers of 1881 and 1882, I saw many seals. Some were evidently the harbor seal (*Phoca vitulina*), while others were too large for this species. On one occasion in particular, a stormy afternoon in July (July 19, 1881), not far below the mouth of the Saguenay, a large seal with a perfectly black head appeared alongside our yacht and rode over several waves before lost to view. Others of the same kind were seen off Portneuf and Manicougan, and between Anticosti and Mingan. Mr. Napoleon A. Comeau, who lives on the north shore near the point where the river expands into the gulf, assured me that the seal in question was the harp, and that he had killed hundreds of them during a residence of more than twenty years on that coast. Mr. Comeau has since sent me, and I have now in my possession, nearly fifty skulls and several skins of harp seals killed between Manicougan shoals and Pt. des Monts. The greater number were shot in March and April, though some were taken in the middle of summer. During the present season (1884), he shot one June 16th and another September 8th, the latter containing a fœtus 55^{mm} in length.

Mr. Comeau has kindly furnished me with the following interesting notes:

"The harp or Greenland seal (*Phoca grœnlandica*) is the most abundant of all our seals, roving up and down the St. Lawrence in its migrations in immense numbers. It is eminently gregarious, hundreds and even thousands being seen together. I myself (in March) have observed one herd at Point des Monts that was more than a mile long; there must have been several thousand in it. They are to be met with at all seasons here, but are most numerous in winter, especially in December, January and the early part of February, at which time they disappear and resort to the ice-fields in the gulf for the purpose of depositing their young, which they begin to do about the 15th of February. As in the case of the harbor seal, the young are perfectly white at birth and have a fine silky coat about an inch in length. If killed soon after birth, or within two or three days, this fur is very fine; but if a longer time has elapsed, especially if the weather

be fine, it falls off quickly and the true hair and color is assumed. When one year old the color is whitish underneath, with occasionally a few black spots, about the size of a ten cent piece, about the neck and breast. These spots are not always present, the color very often being uniform dirty white. On the back there is a broad streak of grayish or blackish color. In the second year there is a slight change. The markings are more numerous, and *are never absent*, the black spots are also larger and more generally distributed all over the body, and the color of the back is not quite so dark or uniform. Third year: most of the black spots having enlarged are merged into each other and form large irregular patches about the size of hen's eggs or slightly larger. The color of these spots also begins to fade, and they have not the same clearness of outline. A few occasionally bring forth at this age, but it is very rare. By the fourth year they have attained nearly their full size, and the two peculiar stripes on the back, from which they derive their name (as it resembles a harp in shape), begin to appear;. the other spots disappear gradually in proportion as these stripes become more distinct and perfect, until at such time, probably at the age of nine or ten years, these two bars and part of the back of the head and nose only are black, all the rest being pure white. After nourishing their young for a period of about three weeks, they are left to their own resources, and strange to say do not seem to take to the water very readily. About this time the females have lost the immense coat of fat they had before giving birth to their young, and take to the water to feed for a short while, when they again return to the ice, at intervals; but by the 20th of March they again make an appearance near the shore and feed voraciously, their chief food being capelin, or herring, but nothing comes amiss, sculpins, flounders, shrimps and other small fry, being swallowed indiscriminately. They do not all leave the ice at the same time, some remaining on it till the middle of April. They bring forth only one young at a birth, though in some rare instances, a few of which have come under my own observation, two are born (in one case I shot the mother containing twins). The males of this species fight very savagely amongst themselves, frequently leaving scars and marks from their teeth and claws.

"Their sense of smell is not very highly developed. I have frequently seen them come to the surface within five or six yards of,

and to the leeward of our boat, and so long as we did not move they did not pay the slightest attention to our proximity. On the slightest movement, however, they would disappear, but if not too shy, or previously shot at, would come up again a little farther off. When shy they do not reappear, except at a long distance, and frequently remain under water from fifteen to twenty minutes. When wounded with a rifle-ball or large buck-shot, unless nearly dead, they will go a great distance; but if struck by small shot, such as number A, they soon come to the surface. The only way in which I can account for this is, that the blood does not flow freely from the small shot-holes in the thick skin of the throat, but forming a clot on the inside, soon accumulates and chokes them; while with a ball or large buck-shot the wound is large and the blood escapes easily, thereby enabling them to breathe freely.

"Great herds of harps sometimes remain in this vicinity [Godbout] from March till June or even July, moving both up and down the river. They often work in towards the shore in the morning to feed on the shoals of herring and capelin, and go out again about seven or eight o'clock. When not pursued or disturbed by hunters this will be repeated day after day. During the months of July, August, September, October and November, they are usually not numerous, though, as before stated, a few are to be seen all the year round.

"I have been told by professional seal hunters that the females have young only every second year. I am inclined to doubt this statement, as it is only founded on the fact that some adult females are shot during the winter without young. I have often shot them myself, but do not consider it conclusive proof of this theory, as the same thing is observed amongst all mammals, though perhaps not quite to the same extent.

From a careful observation extending over several years, I have found that the proportion of males to females is about equal, that is, judging from the number killed annually at Point des Monts (about 250 on an average) where they are shot in the water. Of course when killed on the ice by the sealers in February and March the females predominate. This species and the common seal have only two teats and not four, as erroneously supposed by some."

At my request Mr. Comeau very kindly took the trouble to

visit Manicougan shoals during the present year. Concerning this trip he writes me :

"I took up my quarters on board the light ship there for three days in order to have a chance to see what kinds were likely to keep around the shoals. During that period I saw three large herds of the harp seal pass the light ship, moving east. The first herd, which I saw August 29, contained about five to six hundred *old* harps. The same day in the evening another smaller herd was seen, and on the 31st another herd of a couple of hundred. The captain, who is a very intelligent man and a sportsman, told me that it was nothing unusual but almost of daily occurrence, and that they did not seem to move more in one direction than another, but would sometimes go up one day and down the other."

Mr. Comeau further states that, "The harp is tolerably common as far up as the entrance of the Saguenay. A good many are killed every year, both in winter and summer, around Escoumain (twenty-five miles below the Saguenay). I have myself seen harp seals above Hare island. They were numerous this year (1884) off Godbout, in June and July."

To recapitulate: From the data in hand it appears that the harp seal is a permanent resident in the St. Lawrence; that it spends the summer wandering about, sometimes singly or in small schools, sometimes in large herds; that it ascends the river at least as far as the Saguenay, and is common between Mille Vasches and Manicougan; that it frequents with considerable regularity particular shores and estuaries to feed on the small fish that congregate there at certain states of the tide; that it works down the river in the early winter, and is particularly abundant about Point des Monts in December, January, and the early part of February; that it then passes farther down to whelp on the heavy ice in the gulf; that its young are born during the latter part of February or early March; that as soon as the young are able to shift for themselves the parents at once return, passing Point des Monts in great numbers on their way up the river.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

——Cannot the public press of the United States find something of interest in the scientific literature of the day to give their

readers? Although it is necessary that the leaders of the press should cater to the public taste in order to exist, it is not the less true that they are educators of the public, as they often remind us. That large part of the populace whose opportunities of school or college instruction have not been great, are undoubtedly educated in the affairs of the world by the newspaper press. The responsibility of editors and writers of this mass of daily literature is, therefore, great. It is necessary to portray the events of the stage on which men play their part, for more reasons than one. Without expatiating on this truth, which is denied by some, we refer to two beneficial effects of a general distribution of news. The publication of the good works of men stimulates imitation, and encourages the doers. The publication of the bad deeds of men brings on them that condemnation, which is their natural punishment, and which they naturally fear. It also brands the characters of evil-doers so as to practically protect society from them, more or less.

But does the daily press give a prominence to the good that men do, equal to that which they give to the evil? The most casual reading of our papers will convince any person that the purveyors to the public taste think that they must give the evil a great predominance. To what extent of space the columns of our newspapers are occupied with narrations of all forms of crimes, as compared with the space given to other subjects, everyone knows. When we consider the extent and number of the fields of useful human activity, and the number of persons engaged in them, the amount of space given to criminals in our newspapers is phenomenal. These people have a right to consider themselves, next to candidates for high office, the best advertised part of the community. If they do not become popular heroes and heroines, it is because the people are better than their educators of the press.

And this at a period when the greatest discoveries in science are being made with a rapidity never before known in human history. During the last twenty years truths have been brought to light which will revolutionize all but the most essential principles of the thought of the world, on which, as is believed by political economists, social organization and therefore governments depend. What newspaper ever announced the elaboration of the Gastræa theory of Haeckel; and the presentation of the cœlom theory of the Hertwigs? Who of them knows anything about the theory

of degeneracy of Dohrn and Balfour, or the hypothesis of the origin of the vertebrates of Semper? Which of them ever presented to its readers the solution of the problem of the origin of the existing Vertebrata and the descent of man by the American palæntologists?

Here our popular editor smiles incredulously. What do people know or want to know about Gastræas and cœloms and vertebrates? Well, we ask, what do people want to know about anything? The majority, not much, unless it is presented to them by somebody. But mankind only needs a little knowledge of these subjects in order to develop a strong interest in them. They are likely to do so on all grounds if they have an average amount of mental vitality. Why not? The sciences refer to everything they see, feel and handle, their own being in fact, in the most especial manner. The first thought of the primitive man is to explain the phenomena of nature, and it always will be part of the thought of people who are in any way in contact with nature. And these pursuits and thoughts are not only not harmless but useful. As much cannot be said of the constant absorption of histories of crime.

Gastræas and cœloms and zygosphens and corpora striata, are not more difficult to understand, either as to the thing or the name of it, than puts and calls and straddles; and they have this advantage, that they are always honest. Men brought up on a diet of the first-named articles, are, to say the least, more apt to be honest than those brought up on the last-named. Political news is necessary to every citizen, yet it is mixed with scandal; which although a necessary concomitant of human affairs, is not a wholesome article of mental food. Science contains no scandal, excepting as it reflects on those who violate its laws.

If "the proper study of mankind is man," the study of nature is proper, for nature has made man. The origin of man's body and of his mind are to be derived from the biological sciences; and this once learned, the way to create his future will certainly follow. If the nature of human society be in question, the science of anthropology is gradually explaining it.

But the newspaper press must have credit for what it is doing in these directions. It, however, rarely get beyond applied science; something that makes a material display naturally attracts the attention of the beginner. It is in pure science, however, that the greatest beauties can be found, and no fiction can present the interest which it has for those who give it even moderate attention.

—— The future of scientific research in Philadelphia is not hopeful. The school of biology of the University of Pennsylvania has been mainly placed in charge of men who are nearly or quite unknown in the field of original research, one of whom has publicly stated his doubts of its value! Another of the positions has been filled by a man who is only known as a worker in a widely different field. This arrangement we are told, is due to the fact that the services of these gentlemen are given gratuitously. The school of veterinary medicine has been put under direction of a veterinary physician who knows nothing of general comparative anatomy, so that a fine opportunity of fostering original research has been lost. The Academy of Natural Sciences has become a school for teaching instead of research. The only new enterprise in which it has recently engaged, has been the adoption of a new by-law, which is designed still further to diminish its usefulness.

Both the leading societies of the city allow the occupation of the hours of their regular meetings by amateur disquisitions on the rudiments of science, such as are well adapted for popular lectures, but are totally out of place in such institutions. All this may be traced to the imbecility and selfishness of a few of the leading workers in that city.

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RECENT LITERATURE.

KRAEPELIN'S PROBOSCIS OF MUSCA.[1]—Kraepelin's paper gives the most complete account extant of the structure of an organ which has excited interest since the time of Aristotle. His investigations were chiefly on the proboscis of the Blow fly (*M. vomitoria*), and exclusively on its adult anatomy. The embryology of these parts has not been attempted by Kraepelin, baffled Weismann, and remains yet to be worked out. The following is an abstract of Kraepelin's paper, with pen-and-ink copies of the more important of his thirty-eight fine illustrations. I venture to add some criticisms in the form of foot-notes.

GEORGE MACLOSKIE.

PRINCETON, April 12, 1884.

I. CHITINOUS PARTS AND PRELIMINARY ORIENTATION.—The Muscidæ have nothing corresponding to the mandibles of other insects, and the first maxillæ are in a rudimentary condition; the second (or labial) maxillæ are well developed, coalescing and forming the chief part of the proboscis. There are also two unpaired pieces termed the labrum (oberlippe) and hypopharynx (Fig. 1, *o* and *h*). These lie imbedded in a furrowed channel (Fig. 2, *fp*) on the upper side of the cylindrical labium. The whole structure starts from the summit of a beak-like soft-

[1] Zur Anatomie u. Physiologie des Rüssells von Musca, von Karl Kraepelin, Hamburg. Zeit. f. wis. Zool., Bd. XXXIX, 1883, pp. 683–720, mit Tafel XL u. XLI.

skinned extension of the head. This conical head-part (Fig. 1, *bp*) being retrusible into the firm head-capsule (cranium, *c*) was

Fig 1.—Head of blow fly, all the figures enlarged.

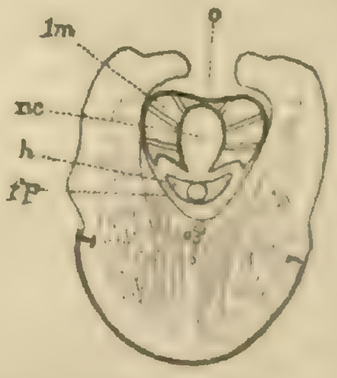


Fig. 2.—Section of Proboscis of the blow fly.

supposed to be the coalescing mouth-parts till Macloskie and Dimmock explained its true nature.[1] I shall call this soft head-part the "head-cone" (the basi-proboscis). The totality of the subsequent parts, including labium, labrum and hypopharynx (the medi-proboscis and disti-proboscis) I call proboscis in the strict sense.[2] (The so-called *epipharynx* has no existence.)

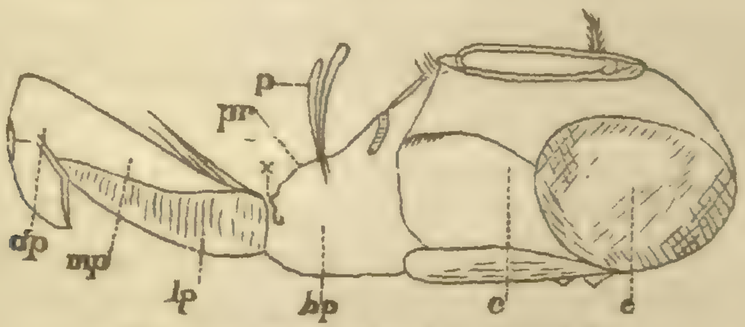


Fig. 3.—Proboscis of the blow fly.

Head-part of Proboscis (basi-proboscis, Fig. 1, *bp*).—The thin-walled basi-proboscis bears a pair of unsegmented palps (*p*) on its upper side, each resting on two chitin-ridges, one of which (*pr*) runs forward to the insertion of medi-proboscis, where it unites with a long rigid chitin-bar (one on each side, the *maxillary tendons*, Fig. 4, *mt*) which runs backward, free under the thin covering-membrane of the basi-proboscis. These bars are the rudimentary first maxillæ, whose palp-bearing part (*pr*) extends backwards coalescing with the roof of the basi-proboscis, and the belt-like pieces under the wall are in connection with the other trophi (especially the labrum) and frequently (in Mesembrina, Aricia,

[1] Macloskie in AMERICAN NATURALIST, 1880, p. 153, read before the N. J. Microscopical Society, Nov. 18, 1879, and N. Y. Academy of Sciences, Dec. 1, 1879. Dimmock's Inaugural Dissertation on the anatomy of the mouth-parts and sucking apparatus of some Diptera. Boston, 1881.

[2] The terms in parenthesis (basi, medi and disti-proboscis) were proposed by me in the article quoted, and are here retained as convenient renderings of the author's terms (kopf-kegel, eigentlicher Rüssel, labella). I do not think it wise to confine the term "proboscis" to the mid and distal parts, as that term is *functional*, indicating the entire mechanism for protrusion, however we may explain the homologies of its parts.—*G. M.*

&c.) bear a small piece (lade) which proves them to be basal parts of the first maxillæ.[1]

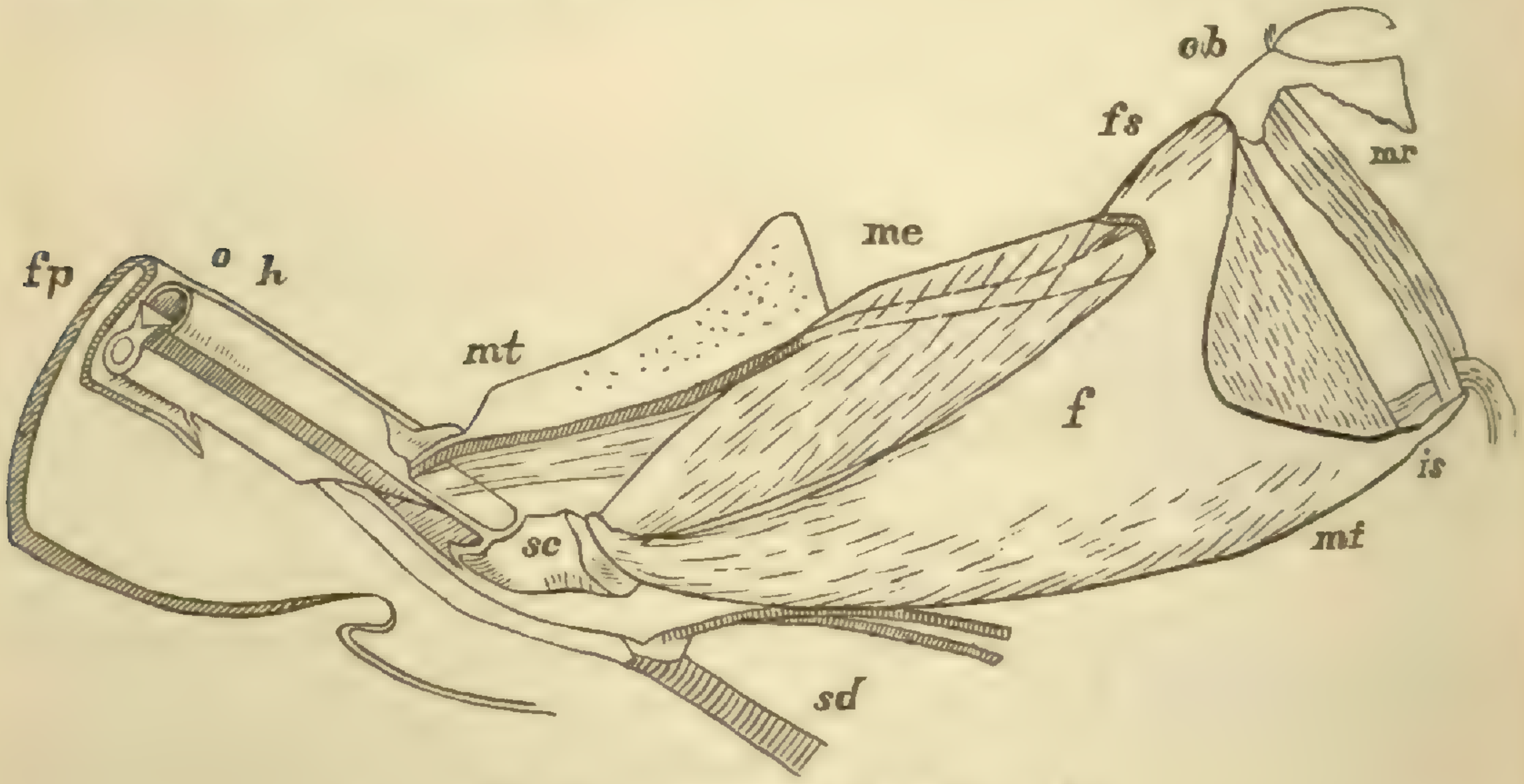


Fig. 4.—Proboscis of the blow fly.

Seen from above, the basi-proboscis shows a strong chitinous horseshoe-shaped thickening, with the open sinus forwards, lying below the soft skin of the basi-proboscis. This is the upper surface of a complex strong structure lying inside the basi-proboscis and variously termed fulcrum, œsophageal sac, pharynx, &c. (Fig. 1, *f*). It is present in all Diptera and Hemiptera, and has been shewn by Menzbier, Macloskie and Dimmock to have nothing to do, morphologically speaking, with the trophi or proper mouth-parts, but is a thickening of the œsophagus-walls, which in Muscidæ send stout processes to the roof of the basi-proboscis and so secure a firm connection with the roof of the cranium.[2]

The general form of the fulcrum reminds one of a Spanish stirrup which is suspended by its supero-posterior processes (Fig.

[1] These chitin-bars (Fig. 4, *mt*) were shewn by me to be the *great tendons* of some of the trophi (*loc. cit.*). They are probably the tendons of the first maxillæ, and beir g large and rigid suggest that as a whole these maxillæ, though not much hardened, are otherwise well developed, a view which is reinforced by the presence of the palps. I shall here use "maxillary tendons" as the rendering of Kraepelin's "spangen der unterkiefer."—*G. M.*

[2] Menzbier, uber das Kopfskelett, &c., der Zweiflügler, Moscow (1880); Macloskie (*loc. cit.*, 1879); Dimmock (*op. cit.*, 1881). I gavè the view that the fulcrum represents the endocranium of other insects. My friend Dimmock cautiously declined to say yes or no to this theory, and Kraepelin, without noticing what I have written on this head, here enunciates the view that it is a thickening of the wall of the œsophagus, a view which I venture to say was shewn by me to be untenable. An œsophageal chitinization must always be towards the lumen of the œsophagus, whereas Kraepelin shews that the fulcrum surrounds the œsophagus. I have compared the fulcrum of Diptera with the structures referred to in such Diptera as the mosquito, and in Hemiptera, and have not been able to decide whether they correspond; as a whole I think the probabilities are against their being homologous. Subsequent consideration, especially with reference to what has been done as to the embryology of the Diptera, has strengthened my faith in the endocranial theory.—*G. M.*

4, *fs*) to a band in the anterior margin of the cranium (*cb*). Its side-walls are strong chitin-plates, with a sinus looking backwards. The sole of the "stirrup" is double, of two chitin-plates superposed, and having a cavity between them, within which the œsophagus passes forwards (Fig. 5, *of*, *uf*). The infero-posterior extremities of the "stirrup" are prolonged into horns, one at each side (Fig. 4, *is*), which are connected by retractor-muscles (*mr*) to the cranial band (*cb*). The maxillary tendons are at their proximal extremities connected by a short muscle with the supero-posterior extremity of the fulcrum, and by a long muscle (*me*) with its anterior horn. Below the floor of the fulcrum are seen muscles running forwards, and also the trachea-like salivary duct (Fig. 5 *sd*).

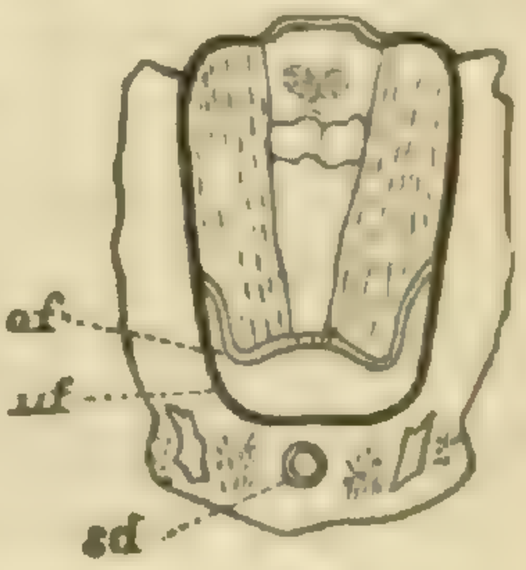


Fig. 5.—Fulcrum.

The Proper Proboscis (medi-and disti-proboscis, Fig. 3, *mp* and *dp*).—When viewed from the side, this part (representing the labium) is a cylinder, anteriorly divided into a two-lobed tip, the labellæ. Viewed from above we see that it has a superior longitudinal canal in which two unpaired chitinous stylets are embedded (Figs. 1, 4, 2, *o* and *h*). The upper one of these two stylets, the labrum (oberlippe, *o*) appears as the direct continuation forwards of the upper anterior margin of the basi-proboscis, and, like all insect appendages, is hollow, enclosing muscles, tracheæ and nerves. As the labium has a deep groove on its upper surface (Fig. 2, *up*), so the labrum has a similar groove on its under surface (*o*), and is in fact an inverted semi-cylinder with double walls. (Its lower wall was once deemed a distinct piece, epipharynx.)

The under proximal extremity is articulated to a small chitin-capsule, described by Macloskie and Becker as a triangular "binding-piece," and overlooked by other observers (Fig. 4, *sc*). This "small capsule" lies directly in front of the fulcrum, whose form it repeats in miniature. The floor of the small capsule is continuous with the under floor of the fulcrum, and the upper plate of the fulcrum-floor partially roofs the small capsule. The side-walls of the small capsule bulge out and are chitinized, giving a basis for the insertion of the under parts of the labrum, whilst the floor of the small capsule supports the second stylet, or hypopharynx.

Hypopharynx.—This, like the labrum, is a hollow cylinder with a longitudinal furrow on its upper surface (Fig. 2, *h*). Its groove meets that of the under side of the labrum, so as to complete a nutritive tube (*nc*) which opens on the distal end of the proboscis, and forms the beginning, or rather the antechamber, of the alimentary canal. Imbibed fluid penetrates this canal, then enters the "small capsule," which serves as a reservoir, passing next into the space between the double floor of the fulcrum, and so on

to the proper œsophagus. The inner cavity of the hypopharynx is, through its whole length, pierced by the salivary duct (*sd*) coming forwards from thoracic salivary glands, advancing below the floor of the fulcrum (Figs. 4, 5, *sd*), and entering the hypopharynx (not piercing it as Meinert supposed) and opening at its distal extremity. I place the proper mouth-opening at the anterior end of the "small capsule," where the labrum and hypopharynx are inserted. The labium, by its grooved upper surface, serves as a case for enclosing the stylets, as with Hemiptera. All the proboscis-parts are bound together by the thin membranous wall of the labium.

Labium (unter lippe).—This is a cylindrical evagination of the basi-proboscis, but furrowed above. Thus it serves as a bed for the nutritive canal. It is divided in front by a median slit into two motile cushions, the labellæ, which Burmeister and Erichson shewed to be the metamorphosed labial palps. The internal cavity is occupied by muscles, nerves, tracheæ and glands. Its under part is much swollen, and is strongly chitinized, the thickening extending up the sides (Fig. 3, *lp*). This under part (inferior labial plate) supports, at its distal extremity, two short, horn-like processes which bear a stout triangular piece. On this piece is inserted a stout chitin-fork (Fig. 6, *if*) whose long legs advance forwards. The fork sends downwards a strong unpaired arcuate band (*ib*). This chitin-fork is joined to the labial plate not merely at its articulation, but also by a folding membrane which unites them along their length.[1] Free vertical motion is thus allowed to the forking parts, but the extent downwards of its excursions is limited by the thin membrane.

Fig. 6.—Side view of labium.

The upper plate (the "furrow-plate," Figs. 4, 2, *fp*) of the labial cylinder forms the bed of the channel which contains the labrum and hypopharynx. The front end of this plate is thickened and bears a strong chitin-fork (the superior fork, Fig. 6, *sf*), repeating in some measure the parts of the inferior fork, the two branches running parallel forwards, and united and limited by

[1] A similar connection by means of membrane is described by me in the maxillary suspensorium of the bee. AMERICAN NATURALIST, 1881, p. 357.—*G. M.*

membrane which connects them with the rim of the furrow-plate. From below this fork an unpaired piece (*sb*) connects it with the inferior fork, and sends backwards a hook-like process.

The thin membrane, which is continuous with the margins of the labial plate, enlarges distally and swells out so as to constitute the two large terminal labellar cushions of the disti-proboscis. In the resting condition these lie with two flat surfaces adjoining, and they have each an inner and an outer surface. The limbs of the lower forks support the outer cushion-walls. The upper forks, whose limbs run parallel, support the inner surface of the cushions. Between these supporting bars the thin membrane is sculptured in a special way. Each branch of the superior fork has, from its place of articulation with the furrow-plate, a chitin-arc running longitudinally (Fig. 7, *ca*); between

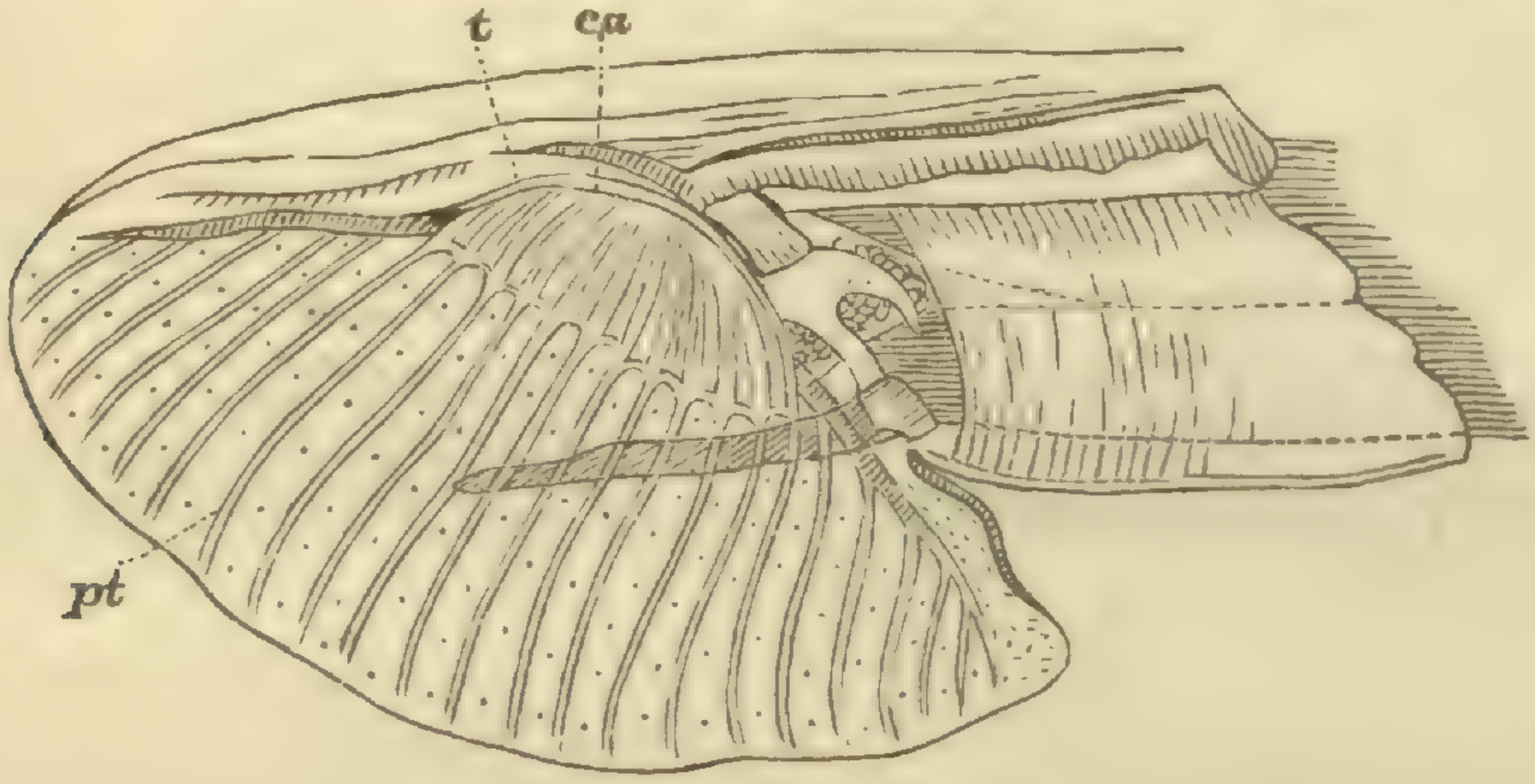


Fig. 7.—Side view of labium.

these arcs the membrane is extended.[1] The membrane has radial folds in bas-relief, soon rising to high relief, forms which depend on secondary foldings of the membrane, called by Macloskie and Dimmock "scraping teeth" or spines (Fig. 7, *t*). There are three rows of such spines, the second and third rows being foldings external to those of the order next below. These are succeeded by foldings of a fourth order which, instead of forming teeth, bend round as semicircular bars and form the beginnings of the often described pseudo-tracheæ (*pt*). The supporting arches thus have (morphologically) the same origin as the teeth. On the outer rim, where outer and inner walls merge, the pseudo-tracheæ, after diminishing distally, terminate. There are also straight supporting rods between the pseudo-tracheæ (Fig. 8, *sr*).[2]

[1] In the housefly there are only one, or occasionally two rows of teeth.—*G. M.*

[2] These supporting rods are not in the Housefly. I may add to the above that the projecting margins of the pseudo tracheæ are crenulate with deep sinus between the adjoining crenellæ. The supporting arcs are forked alternately at opposite extremities (AMER. NAT., 1880, p. 153, Fig. 1, *C*), and each crenella is supported medially by the simple extremity of one arc, and at its two margins by the semi-forks of adjoining arcs; so that the deep sinus between crenellæ is bounded by the forked end of an arc. The fine membrane between the pseudo-tracheæ is hexagonally areolate, like the facets of the eyes, the areoles having sunken boundaries (which may flatten out when the labellæ are expanded). My observations are from the *housefly*.—*G. M.*

II. Musculature and Motile Mechanism.—1. *Movements of the basal parts of the Proboscis.*—There are two pairs of retractor muscles. One pair arise from the anterior band of the cranium (Fig. 4, *mr*) and are inserted on the inferior suspensor processes (*is*) of the fulcrum. The other pair arise from the postero-basal plate of the cranium and reach forward so as to be inserted on a cross-ridge (Fig. 3, *x*) near the end of the basi-proboscis. By their contraction they retract the thick wall-plate of the labium telescopically into the basi-proboscis. The second pair also flex the hypopharynx on the "small capsule," and the whole labium upon the fulcrum; we may term them "flexors of the labium."

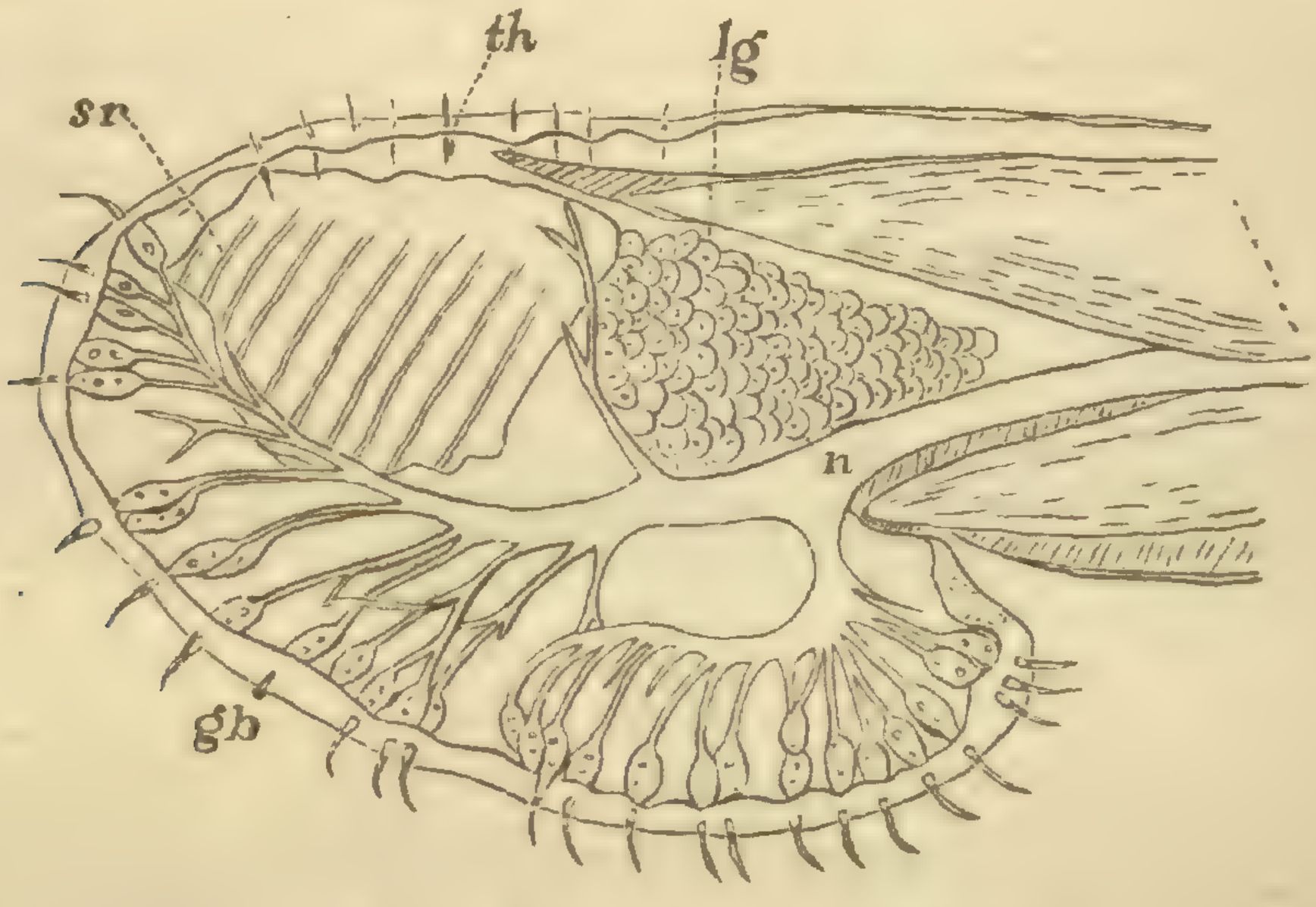


Fig. 8.—Nerves, etc., of labium.

Two pairs of weak muscles arise from the sides of the occipital foramen. One pair of these aid the unfolding of the basi-proboscis. The other run forward over the "small capsule" and seem to be inserted in the base of the labrum; they may be retractors of the labrum.

The *mode of protruding* the proboscis involves a more difficult problem. The muscle which Becker describes as drawing the fulcrum around its hinge, has no existence. The tracheal apparatus comes to exercise a powerful influence at this point. The large air-trunks after entering the head by the occipital foramen enlarge to form (seemingly two) capacious air-sacs, which, when the proboscis is extended, fill all the cranial cavity except what is occupied by the nerves and the invaginated "cranial bladder" (Fig. 1, *b*). This cranial cavity is serviceable for the retraction of the proboscis, as by the collapse of the tracheal sacs through the withdrawal of air from the head, a vacant space is left for the reception of the fulcrum. (I renounce the view once held by me that the cranial bladder aids in retracting the proboscis.) The inspiratory mechanism of the trunk by driving air towards the head causes the protrusion of the basal parts of the proboscis. The

view that the proboscis was protruded by air-pressure was long ago enunciated by Gleichen, and has been recently established by Macloskie and Dimmock by experiments made under water. I have found traces of a muscle in the head by whose action such inspiration may be assisted.

Simultaneously with the extension and swelling of the basi-proboscis, the extension of the medi-proboscis takes place. This is provided for by the articulation of the hypopharynx and labrum on the "small capsule." The long maxillary tendons (Fig. 4, *mt*) are firmly united to the chitin-wall of the labrum. From the proximal terminal knob of these tendons a strong muscle proceeds to the front horn of the fulcrum (Fig. 4, *me*). Another short muscle binds the same knob to the superior wall of the basi-proboscis. The larger pair of these muscles are extensors of the medi-proboscis.[1]

2. *Movements of the Labellæ* (disti-proboscis).—The bifurcating framework already described permits much change of the labellæ. Muscles coming from the rigid inferior plate of the labium reach the branches of the forks, and control their movements. The muscles by contracting open and spread out the labellar cushions. As the muscles become relaxed the elasticity of the bars and fork-limbs suffices to bring the whole back to its position of rest. There are no antagonizing muscles to the fork-retractors. After death these retractors act so excessively as to turn the cushion-like labellar faces outwards.

As to the swelling of the labellar-cushions, Macloskie and Dimmock represent the tracheal air as the means of swelling. But careful sections shew that the tracheæ do not enter the labellar cushions, and there are no bladder-enlargements as must be present for such an office. All the parts of the labellæ not occupied by organs are filled with blood whose pale corpuscles can be seen. Hence it is clear that the swelling of the labellæ is caused by inflowing blood, as Becker supposed.[2]

[1] I have found that these muscles by alternately contracting on each side of the proboscis move its tip from side to side. The connection of the maxillary tendons with the labrum and hypopharynx is so pliable (at least in the housefly) that I question the extensor function here assigned to its muscle.—*G. M.*

[2] On this subject I must join issue with the distinguished author. The presence of blood in the lamellæ does not disprove their being distended mainly by air, if independent evidence to this effect be forthcoming; and the finer tracheal branches and sacs, not being chitinized, are not readily recognized, and may be represented by what are described below as glands. Kraepelin's figures shew that he has not sufficiently examined these structures in living specimens, for they all represent the disti-proboscis in a collapsed condition; and no reference is made to the fact that when the proboscis is distended there is always a large swelling in the inferior angle between the medi-and disti-proboscis. On cutting or pricking this swelling under water, one or two air-bubbles escape, and the labellar cushions as well as the more proximal parts instantly collapse. Nor can they be again protruded. Of course the fine air-reservoirs, when under dissection, are in the collapsed condition, and easily elude observation; but they may be seen to swell as by peristaltic movements in living specimens.—*G. M.*

3. *The Suctorial Mechanism.*—The suctorial canal begins where the paired limbs of the upper labellar fork are fixed on the extremity of the upper labial plate. The entrance is guarded by bristles to prevent the escape of fluid. Behind this are seen the tips of the labrum and hypopharynx, between which the entering fluid penetrates so as to reach the proper œsophagus.

The labrum having radial muscles between its two plates (Fig. 2, *lm*) can enlarge its lumen and so effect suction. At the triangular "small capsule" the action of the fulcrum comes into play, its muscles raising the upper floor-plate (Fig. 5, *of*), and so enlarging the cavity below and continuing the suctorial process. Thus the fluids are absorbed and forced towards the stomach.

For dissolving solid substances the secretion of the glands is provided. There are three pairs of salivary glands. The chief ones are in the thorax, with the long salivary duct resembling a large trachea (Figs. 1, 4, 5, *sd*). A second pair is in the distiproboscis (Fig. 8, *lg*), large-celled round masses with a common duct opening near the tip of the upper labial plate. A third collection of salivary glands is at the passage of the fulcrum into the œsophagus.

The salivary secretion is spread over the labellar cushions by means of the pseudo-tracheæ.[1] Sugar, bread-crumbs, &c., being porous absorb the fluid; it is not the sugar that is absorbed by the saliva, but the saliva by the sugar.

III. Hairs and Sense-Organs.—The proboscis is covered with short hairs not supplied with nerves. Besides these there are three kinds of special hairs:

(1) The *tactile* hairs are on the upper rim of the labellar cushions (Figs. 8, 9, *th*), hollow, having a nerve with a ganglion (*tg*) below.

(2) Labial glands with bristles are on the outer margin of the labellæ (Figs. 8, 12, *gb*). Each of these bristles is supplied with a duct leading from a many-celled mass, and is grooved at one side as if for conveying a secretion outwards (Künckel and Gazagnaire deem these to be sense-organs with nerve-ganglia).

(3) There are also taste-organs over the surface of the labellæ, between the pseudo-tracheæ (Fig. 7, indicated by dots, and Figs. 10, 11). Each hair has a chitinous basal ring; its nerve is ganglia ted, and is perforated by an axis cylinder which reaches the surface, indicating that here we have to do with a genuine organ of special sense.

[1] An easy experiment illustrates this. Press out the proboscis, and before the labellæ swell, their surface is covered with saliva like a drop of dew. Further pressure swells the labellæ, and instantly the saliva disappears, being drawn into the now expanded pseudo-tracheæ by capillary action.—*G. M.*

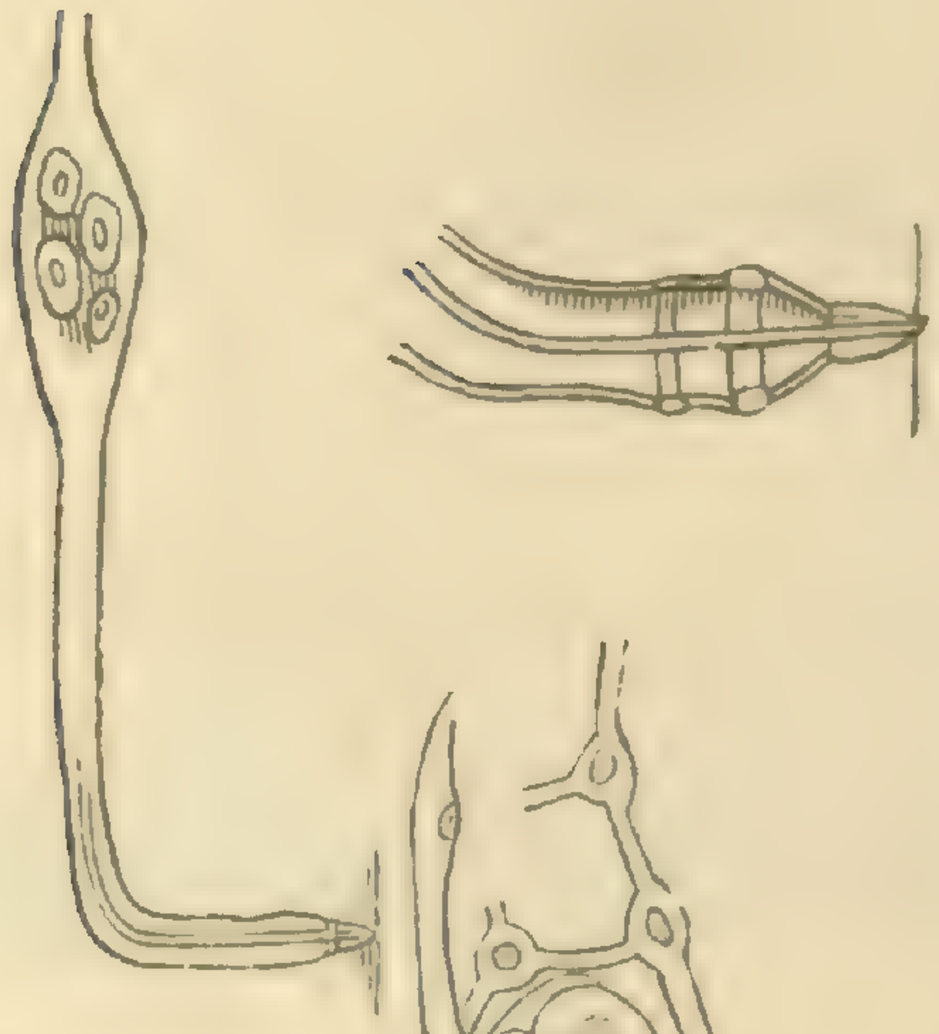
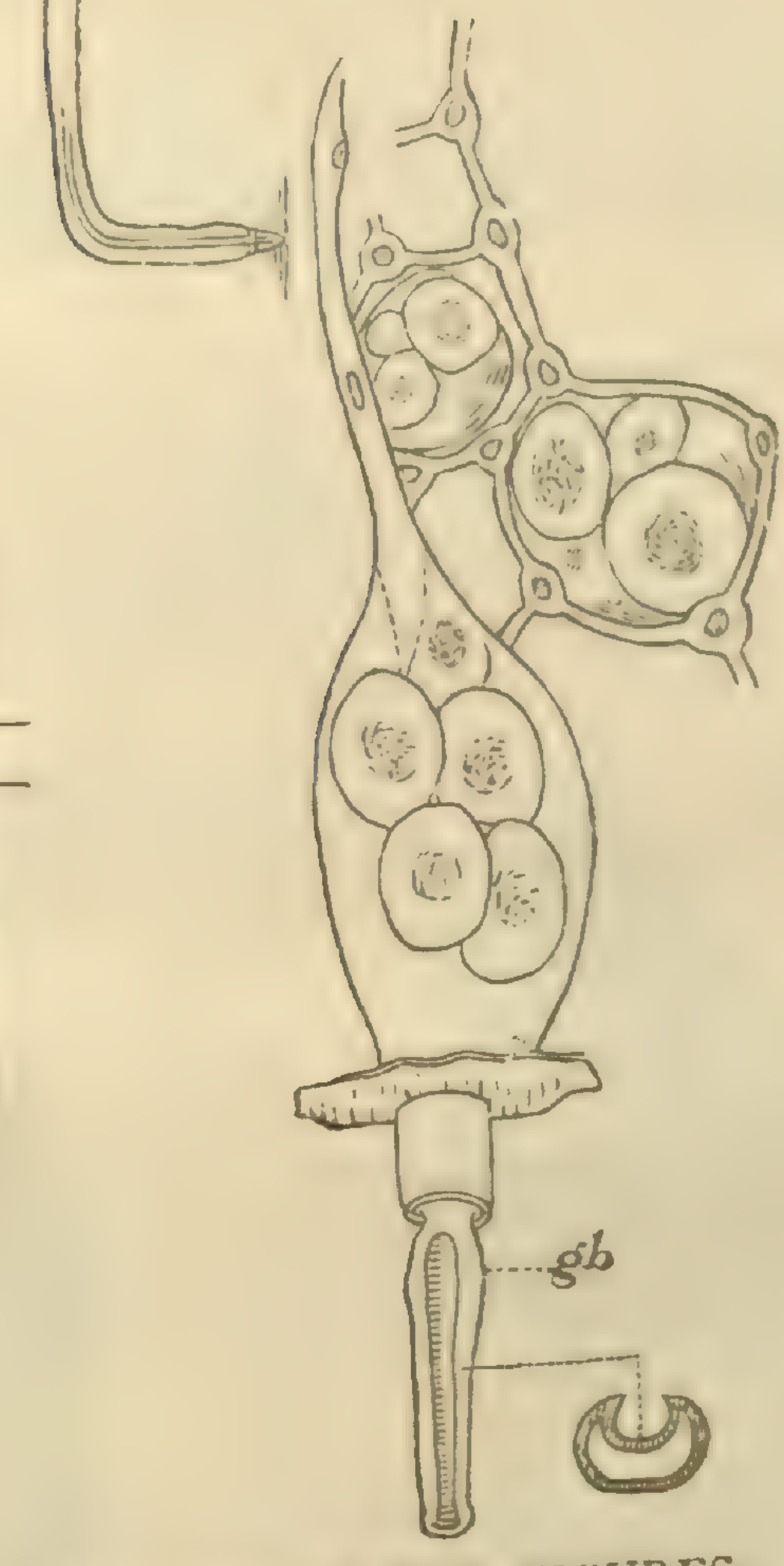


Fig. 11.

Fig. 10.



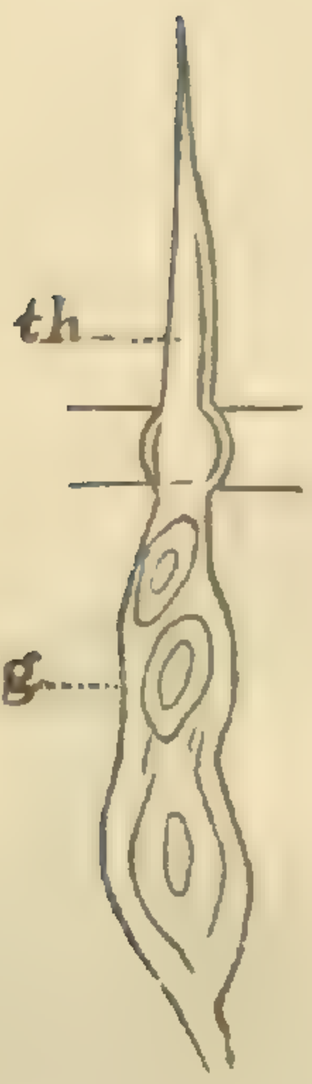


Fig. 9.

Fig. 12.

EXPLANATIONS OF THE FIGURES.

FIG. 1.—Median section of Fig. 1.
FIG. 2.—Transverse section of medi-proboscis.
FIG. 3.—Head of *Musca vomitoria*, with extended proboscis. Side view (left).
FIG. 4.—Basi-proboscis with part of medi-proboscis, with the covering membrane removed (including part of Kraepelin's Fig. 3).
FIG. 5.—Transverse sections of basi-proboscis and fulcrum.
FIG. 6.—Supporting parts of disti-proboscis.
FIG. 7.—Disti-proboscis, with pseudo-tracheæ.
FIG. 8.—Longitudinal section of disti-proboscis.
FIG. 9.—Tactile hair.
FIGS. 10, 11.—Taste organs.
FIG. 12.—Dermal glands with gland-bristle and its cross-section.

REFERENCE LETTERS.

(For all the figures.)

b, Crainal bladder.
bp, Basi-proboscis.
c, Cranium.
ca, Chitin-arch supporting pseudo-tracheæ.
cb, Band on front of cranium.
dp, Disti-proboscis.
e, Eye.
f, Fulcrum.

fp, Furrow-plate.
fs, Suspensory process of fulcrum.
gb, Gland-bristles.
h, Hypopharynx.
ib, Inferior labellar band.
if, Inferior labellar fork.
lg, Labellar glands.
lm, Muscles of labrum.
lp, Inferior labial plate.
me, Extensor muscles.
mp, Medi-proboscis.
mr, Retractor muscles.
mf, Muscle of fulcrum.
mt, Maxillary tendon.
n, Nerve.
nc, Nutritive canal.
o, Maxilla (oberlippe).
of, Upper plate of floor of fulcrum.
op, Upper labial plate.
pr, Palp-bearing ridge.
ps, Pseudo-tracheæ.
sb, Superior labellar band.
sc, Small capsule.
sd, Salivary duct.
sf, Superior fork.
sr, Supporting rods.
t, Teeth.
tg, Tactile ganglion.
th, Tactile hairs.
up, Under plate of floor of fulcrum.
x, Cross-ridge near top of basi-proboscis.

OBER'S TRAVELS IN MEXICO.[1]—In point of interest to the public and as a contribution to popular geography this book should meet with favor. To the naturalist desirous of learning something of the physical features of the vast country here described, and of its more prominent biological and ethnological characteristics, Mr. Ober has done a favor.

The work is divided into three books, devoted to Yucatan,

Aboriginals of Mexico.

Central and Southern Mexico, and the border States next to the United States, so it will be seen that the author covers a large extent of ground, indeed, the number of miles traveled (nearly a

[1] *Travels in Mexico and Life among the Mexicans.* By FREDERICK A. OBER. With 190 illustrations. Boston, Estes & Lauriat. 8vo, pp. 672.

Donkey Boys of Guaymas, Gulf of California.

thousand on horseback) exceeded 10,000, and although he usually went over the routes traveled by the diligence, steamer or railroad, Mr. Ober kept his eyes open and records his experience in a graphic, pleasing way, and the illustrations, which are passably good, add to the attractiveness of the narrative.

On his way to Uxmal, which is briefly described and well illustrated, Mr. Ober visited the water caves of Yucatan, which he thus describes :

"An hour after leaving this hacienda we reached that of

Indian Carrier, Yucatan.

Mucuyché, famous for its *cenote*, or water-cave. There are no rivers in Yucatan that flow above ground, and the people are wholly dependent upon the clouds for their supply of water, and upon the rivers that run beneath the surface. The whole province is one vast table of coral rock, beneath which flow large streams and even rivers. These break out at intervals into caves and caverns formed by earthquakes and the pressure of the water,

though sometimes the supply is due to the infiltration of surface water into natural grottoes in the coral rock. The Indians, centuries ago, marked the courses of these subterranean streams by heaps of stones, and their cities were always built near or about the water-caves, as is now shown by their ruins. These caves, where the rivers appear to the light of day, are called *cenotes.* There are many in Yucatan, and in Merida are several, utilized as bathing places—most refreshing resorts in the heat of day. The

Indian Boy, Yucatan.

cenote at Mucuyché is a cavern, perhaps forty feet deep, broken down at one side, forming an arch of limestone with every shape of stalagmite and stalactite, the roof full of holes in which were the nests of hundreds of swallows and hornets. A flight of stone steps leads from the delightful garden above, and some avocado pears and cocoa palms growing at the bottom thrust their crowns above the general level of the ground. The water is clear and very deep

at the east end of the cave, with many fish in it—'cenote fish'—which are said to be blind, like those in the Mammoth cave. Roots of trees hang pendant in clusters, behind which lizards and iguanas dart along the ledges; swallows circle in dense masses about the arch, forming a complete ring, and making a deafening, whirring noise with their wings."

Another chapter is devoted to Mayapan and the Mayas, the author indulging in severe but well merited criticism of the methods of M. Charnay and of Dr. L. Plongeon, and for their hasty conclusions, based on preconceived notions, as to the age and builders of the ruined cities they have so zealously explored.

We are then treated to accounts of the logwood forests and to scraps of the natural history of the north coast of Yucatan. Palenque was not visited by the author, though a chapter is devoted to this engrossing topic.

In the account of Mexico the chapter on Popocatapetl and the account of the ride from Vera Cruz to Mexico brings out clearly the nature of the better known Mexican volcanoes and of the three regions passed over in going from Vera Cruz to the City of Mexico. In Southern Mexico the palaces of Mitla, among which Mr. Ober spent a few days, are briefly described.

Though written to please the tastes of the public, we may be sure that the narrative is reliable, the information authentic, and that this book is, all in all, the best hand-book of Mexico the intending visitor to that interesting country can take along with him.

BRIEFER COURSE IN BOTANY.[1]—We have examined this little volume with more than usual care. Two things command attention at once: First, that it is written by a teacher of experience; and second, that its author is both an acute observer and a thoroughly posted compiler. It is, in its text, a fresh book, that is, the presentation of the subject matter is done in such style as indicates that the author had thoroughly considered both the language and order of presentation of the facts.

The appearance of this book is most opportune. Botany, in this country, has largely passed through the preliminary period of *systematic work exclusively*. The great masters have arranged our vegetable hosts into an order which will, without serious change, stand for the next twenty years or more. And the growing need, as well as the growing desire, is to know more of the origin, structure and evolutionary tendencies of the individual plant. Good, cheap microscopes can now be had which make such studies possible. The Briefer Course in Botany, then, is just the book required to foster the existing disposition. There is nothing superficial in it, nothing needless introduced, nothing

[1] *American Science Series. Briefer Course in Botany.* By CHARLES E. BESSEY, M.Sc., Ph.D., professor of botany in Iowa Agricultural College. pp. 292. Published by Henry Holt & Co.

essential left out. The language is lucid; and as the crowning merit of the book, the author has introduced throughout the volume "*practical studies*" which direct the student in his efforts to see for himself all that the text teaches. It is hardly possible to estimate too highly the value of these "*studies*" as an educational force.

On the first page of the brief *Preface* the author gives his reasons for introduction of the terms Zygophyta, Oöphyta and Carpophyta. It is enough to say that to any one these reasons should be satisfactory. To the teachers who know the confusion caused in the minds of pupils by the older nomenclature, this change will probably be thoroughly welcome. It is an oversight that instead of asexual the author did not use the term nonsexual, for besides being contrary to best usage, asexual, by slight typographical blunder, is often made to read a sexual, just what is not intended. Hence asexual should not be used or perpetuated.

As indicating the scope of this little book we give the chapter headings:

I. Protoplasm and Plant-cells.
II. The Tissues of Plants.
III. The Groups of Tissues, or Tissue Systems.
IV. The Plant Body.
V. The Chemistry and Physics of Plants.
VI. Classification and Distribution of Plants.

A glance shows that the student is here plainly led from the natural foundation on simple facts up to the latest views and broadest generalizations.

We have but a single criticism to make. One more chapter is needed, which should briefly explain the terms used in analysis of plants.

There is a danger that we may run from one extreme to another in our teaching, and in our new love for morphological botany, neglect systematic botany too much. A part never can be greater than the whole, and we regret the tendency, already too marked, of being content to study cells and cell growth and aggregation, without being able to name the plant on which the observations are made. No one is better qualified than Professor Bessey to add this needed chapter. Another edition is sure to be called for soon, and when it appears we hope to find this one chapter added to what is already a most important and admirable work.—*J. T. Rothrock.*

THE PEOPLE'S CYCLOPEDIA.[1]—This work, in three royal octavo volumes, contains a great deal of information in a condensed form. What it may be in other directions we do not know, but we cannot speak highly of its scientific value. But two well-

[1] Phillips and Hunt, New York. Edited by W. H. DePuy, LL.D., 1883.

known scientists appear as editors, Professor C. F. H. Peters and Professor Alex. Winchell, and their influence has not been largely felt. To give an idea of its standing, we quote two points. Of the Dinosauria it says "the principal genera are Megalosaurus, Iguanodon and Hylæosaurus!" This information, now a quarter of a century old, indicates that the editors have not heard of the many American genera of this order. Of the doctrine of development it says (p. 533): "As a hypothesis the theory has great plausibility, but lacks the support of one accredited instance of the organization of species by natural selection." The list of scientific men at the end of the last volume is absurdly defective. Johnson's encyclopedia gives much fuller information on American subjects.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Mr. Graham's Ascents of Himalayan Peaks.*—In the August number of the Proceedings of the Royal Geographical Society Mr. W. W. Graham gives an account of his travels in the Himalayas. He reports that Kanchinjinga is inaccessible, but believes that the circuit of the great peak could be made in nine days, although one pass of 20,000 feet would have to be crossed. The peaks are set with rocky aiguilles impossible of ascent, for beside them the Matterhorn is a mere dwarf. In an attempt to ascend Danagiri (23,186 feet G. T. S.) Mr. Graham and his companion reached 22,700 feet, and saw below them Mount Monal (22,516) and A_{22} (21,001), but were compelled to return by a hail storm. In one place they found the map of the topographical survey highly inaccurate, "one whole range omitted, glaciers portrayed where trees of four feet thickness are growing, and the hill shading generally entirely imaginary." Peak A_{21} (Mount Monal) was successfully attempted, but A_{22} was found to terminate upwards in an inaccessible precipice. Jabonu (21,300–21,400 feet G. T. S.) was also ascended, and on another occasion Mr. Graham and two companions reached to within about 40 feet of the summit of Mount Kabru (23,700 feet). North-west of this peak, less than seventy miles, lay Mount Everest, said to be the highest mountain in the world, but, in the judgment of Mr. Graham and of his skilled Swiss guide, Emil Boss, surpassed by two unknown peaks, one rock and one snow. The travelers agree that the Himalayan glaciers lie at a greater angle than the Swiss, and that the general slope of the peaks is greater. None of the inconveniences usually described as experienced by travelers who ascend to great heights were felt, but the pace of the heart increased greatly, and its beatings became audible. Mr. Graham thinks it possible that the headache, nausea, bleeding, etc., suffered by some, arise from a weak heart. At 22,000 feet,

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

upon the slopes of Mount Kabru, a pair of snow-white hawks were seen flying as easily as at lower levels. The ascent of Kabru is the highest yet accomplished by man. In the discussion which followed the reading of Mr. Graham's paper, it was elicited that the two unnamed peaks near Mount Everest had been seen before by native surveyors.

ASIATIC NOTES.—There is no satisfactory evidence, according to Professor R. Lenz, that the Oxus flowed into the Caspian before the thirteenth century, as the Arabian geographers of the ninth century, who have been quoted in proof of this connection, appear to have confounded the Caspian with the Aral. It is known that the river had two branches in the thirteenth and fourteenth centuries, but the branch emptying into the Caspian probably ceased flowing in the sixteenth century. This agrees with Turcoman traditions. In 1850 and 1869, during great floods, the waters of the Amu Darya penetrated into Lake Sara Kamysh. The level of the Caspian is slowly but steadily falling, and the fresh-water seals are fast diminishing in number.——A recent issue of Petermann's Mittheilungen contains a map showing the route pursued by A. Regels in his journey through Darwas in the last months of 1883. The Chingan, a tributary of the Oxus, was followed almost to its source in the Garma glacier.——Mr. Holt Hallett has returned to Bangkok after a successful expedition to the Shan States, during which he has surveyed over 1500 miles of route, determined the position of the Shan ranges, and made vocabularies of the aboriginal races and notes on the histories of the several States.——The French traveler, M. Cotteau, who has recently visited Sarawak (Borneo) says of that colony: "It is a curious phenomenon to see a population of 300,000 Dyaks, Malays and Chinese governed by thirty Europeans economically, almost without written laws, without an army, and without police."——M. Lessar has explored the middle portion of the country watered by the Murghab, a part never before traversed by Europeans.——A recent number of Petermann's Mittheilungen contains a map of Merv and of the Russo-Persian boundaries in the vicinity, with the routes of the Russian engineer, P. M. Lessar. Between Askabad and Sarakhs the distance is 280 versts, and the route lies along the "Alek" or foot of the mountains which form the boundary between the two countries. A few miles north of Sarakhs the boundary attains the river Herirud, which here flows toward the south, and divides Persia from Russia until the Borchut range, a continuation of the Paropamissus, is reached. These mountains form the northern boundary of Afghanistan, and the Russian frontier reaches to within twenty-five miles of Herat. Merv was formerly erroneously supposed to be 1900 feet above the sea, but is really only 800.

AFRICAN NOTES.—M. Dutreuil de Rhins has communicated to the Geographical Society of Paris notes from De Brazza, by which it appears that the land route between Franceville and the Alima has been shortened from seventy-five miles to fifteen or twenty through the discovery of an affluent of the Ogowé. On his last visit to the Makoko M. de Brazza was accompanied only by a man and a boy. The French Mission at Cape Lopez now has fifty huts, and proves to be salubrious.——Mr. H. H. Johnston writes to the Royal Geographical Society from Urura on the mountain Kilimanjaro. He speaks of it as "one of the loveliest sites in the world. Above me towers into the deep blue heaven the snowy head of Kibo', around me are green hills and forest-clad ravines in whose profound depths great cascades of water leap from rock to rock and splash the fronds of luxuriant ferns; before me lies spread out a vast blue plain—'all the world,' as my host, the chief Mandara, proudly says—and my view southward is only bounded by the distant horizon."——Clemens and Gustav Dehardt have recently explored the Tana river and its two mouths. Massa, the farthest point attained, is found to be in 39° 47′ E. long. instead of in 38° 20′, thus the river runs in a more southerly direction than has been supposed.——Capt. Brandon Kirby, probably the first white man who has penetrated the country due north of Coomassie, and reached the southern limits of those inland nations who have hitherto been prevented from communication with the seaboard by the formerly impassible barrier of Ashanti power, does not think that that power is likely again to regain its ascendancy over the neighboring tribes. Coomassie was ruined during the civil war, but is being rebuilt. Human sacrifices are now forbidden by the new king, Quaco Duah.——A Portuguese expedition under Major H. de Carvalho left Loanda June 10th, with the object of establishing commercial relations with the Muata Yanvo. Thence the expedition will proceed to Mozambique. (A Portuguese, Joaquim Rodriguez Graca, 1845–7, was the first to make known in Europe the kingdom of the Muata Yanvo.)——The German African Association has sent out a new expedition for the exploration of the southern part of the Congo basin, under the command of Lieut. E. Schulze, with Lieut. Kunth as topographer, Dr. Wolff as anthropologist, and Dr. Buttner as naturalist.——According to M. de Foucauld, who has recently returned to Paris from a journey in Morocco, the sultan of that country (Mulai-el-Hassan) has only an extremely limited authority, since many tribes are not only rebellious, but independent. His empire is really bounded by the lower valleys of five large rivers, *i. e.*, to the parts occupied by the Arab race. The vast regions peopled by Imaziren (Berbers) recognize no power save their own chiefs. The conflict of influences on the Congo has caused the invention in Germany of a "Game of Congo" in which sixteen pawns, bearing the colors of England, France, Germany and Portugal, operate on a large map.

AMERICA.—*The Work of the Greely Expedition.*—The geographical work of the Lady Franklin Bay Expedition, according to the account given by Lieut. Greely at the British Association, covers nearly three degrees of latitude and over forty degrees of longitude. Lieut. Lockwood's journey to the north added nearly 100 miles of coast line beyond the farthest point seen by Lieut. Beaumont, of the Royal Navy. There were no indications that the most northern point of Greenland seen, 83° 35′ N. lat., 38° West long., was the northern termination of Greenland. The coast presented numerous fjords, with many outlying islands, and the interior, as seen from an elevation of 2000 feet, consisted of confused masses of eternally snow or ice-clad mountains. The coast-line was high and precipitous, the formation schistose slate with a little quartz. The arctic poppy and several saxifrages were seen, as were also traces of the polar bear, lemming and arctic fox, and a hare and a ptarmigan were killed. A snow bunting was heard. A curious fact was the existence of a "tidal crack" extending from Cape Bryant along the entire coast, stretching across the fjords in a direct line from headland to headland, and varying in width from one yard to several hundreds. Inside the crack was rough hummocky ice, while outside lay the palæocrystic ice. The interior of Grinnell land from the 81st to the 82d parallels, between Kennedy and Robeson channels and the Western Polar ocean, was found entirely free from snow in July, except on the very backbone. Vegetation abounded, willows, saxifrages, grasses and other plants completely covered large tracts of ground. These valleys afford good pasturage for musk cattle which feed toward the sea-coast in the summer and withdraw to the interior toward winter. Raised beaches, marine shells and driftwood indicated the recent elevation of this region above the sea. From the 81st parallel southward to Hayes sound between the heads of Archer and Greely fjords, stretches the perpendicular front of an ice-cap, the average height of which is not less than 150 feet. From the summit of Mount Arthur (4500 feet) a similar ice-cap could be seen north of the Garfield range, with extensive glaciers projecting through each mountain gap. The southern limit of this cap closely coincides with the 82d parallel, and its area must be about 6000 square miles. The line of perpetual snow on Mount Arthur was 3500 feet above the sea, while the crest of Grinnell Land was 2500 above the sea in front of the southern ice-cap, and 3000 feet near Mount Arthur.

GEOLOGY AND PALÆONTOLOGY.

THE STRUCTURE OF THE COLUMELLA AURIS IN CLEPSYDROPS LEPTOCEPHALUS.[1]—The columella auris in *Clepsydrops leptocephalus* Cope, is bifurcate at the proximal extremity. The shorter expanded

[1] Abstract of paper read before the National Academy of Sciences Oct. 16, 1884

extremity is the stapes proper. The oblique perforation of its base is a character which has not been hitherto observed in any reptile, not even in the allied form Hatteria (Huxley). If, as is probable, the perforation is homologous with the foramen of the mammalian stapes, we have here another point of resemblance to this class. The longer proximal branch of the columella has only half the width of the stapedial portion, and its long axis makes an obtuse angle with that of the latter. It is perhaps the ossified suprastapedial cartilage of Huxley, which that author states (Anatomy of Vertebrated Animals, p. 77) is not ossified in any of the living Sauropsida. Huxley supposes this cartilage to be the homologue of the incus, and remarks[1] that in a young Mammalian fœtus "it appears exactly as if the incus were the proximal end of the cartilage of the first visceral arch." This identification will require an excessive abbreviation of the stapes in Clepsydrops, and until this is proven I prefer to call this process the *epicolumella* (see Pl. XXXVIII, fig. 2). The columella now described, resembles a rib, of which the epicolumella resembles the head, and the stapes the tubercle. If this process be the incus, the stapes is shortened as in the majority of Mammalia, unless the primitive suture between the two be longitudinal. The form and position of the true stapes give support to the view of Salensky, that it is not part of a true visceral arch, but is developed in the connective tissue surrounding the mandibular artery. We see that in this Pelycosaurian it is not the proximal part of the arch, and surrounds the mandibular artery. The columella is divided into at least two distinct elements. This is clearly indicated by its abrupt truncation distally by a rough sutural surface. If there be but one bone distad to the stapes, it is homologous with the cartilage, which has been shown by Peters[2] to be distinct in Hatteria, crocodiles and various lizards. It is the triangular ligament of Cuvier. If the suprastapedial be incus, this element is malleus; and it is usually identified as such by the older anatomists. In this structure we have evidence that the hypothesis that the articular and quadrate bones are homologous with the ossicula auditus, is incorrect. The Pelycosauria will probably come under the head of "Sauropsides malleoferes" of Albrecht. We have here an approximation to the Mammalia in two points: (1) The perforation and ? shortening of the stapes; (2) and the ossification of the incus, which (3) is distinct from the malleus, thus furnishing homologues of the principal ossicles of the ear. It is unnecessary to observe, however, that this part of the skeleton does not resemble the corresponding part in the known Monotremes.

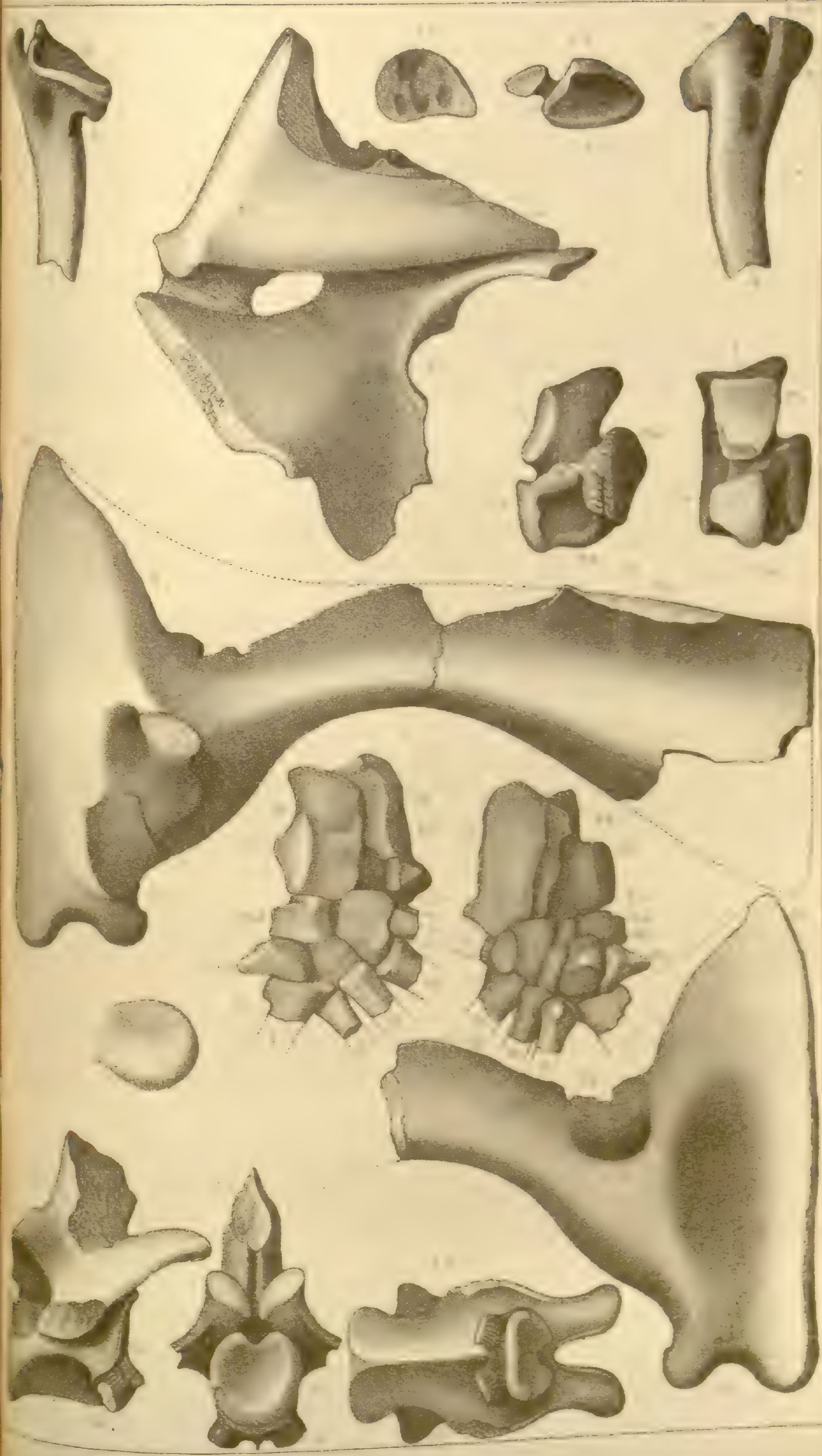
EXPLANATION OF PLATE XXXVIII.

(I am indebted to the American Philosophical Society for the use of this plate.)

FIG 1.—*Clepsydrops leptocephalus* Cope, right quadrate bone (Q) with condyle and zygomatic process (*z*) from the right, or external side. *Pt*, pterygoid bone of

[1] Proceedings Zool. Society, London, 1869, p. 391.

[2] Monatsberichte der Academie Sciences, Berlin, 1868 (p. 592)—1870.



same side displaced so as to be in plane of quadrate, and to be seen from inferior side. One-half natural size.

FIG. 2.—Columella auris of the individual of *Clepsydrops leptocephalus* represented in fig. 1; internal side. Fig. 2*a* external side; 2*b* proximal extremity; *2c* distal extremity; *st*, head of stapes; *ecol*, epicolumella; *d*, distal articular surface, especially represented in fig. 2*c*. All figures are half natural size, excepting 2*c*, which is natural size.

FIG. 3.—Left half scapular arch of a Pelycosaurian, less clavicle and episternum, one-half natural size. *sc*, scapula; *cl*, facet for clavicle; *cor*, coracoid; *ec*, epicoracoid; *s*, open suture between coracoid and epicoracoid, indicating the immaturity of the animal.

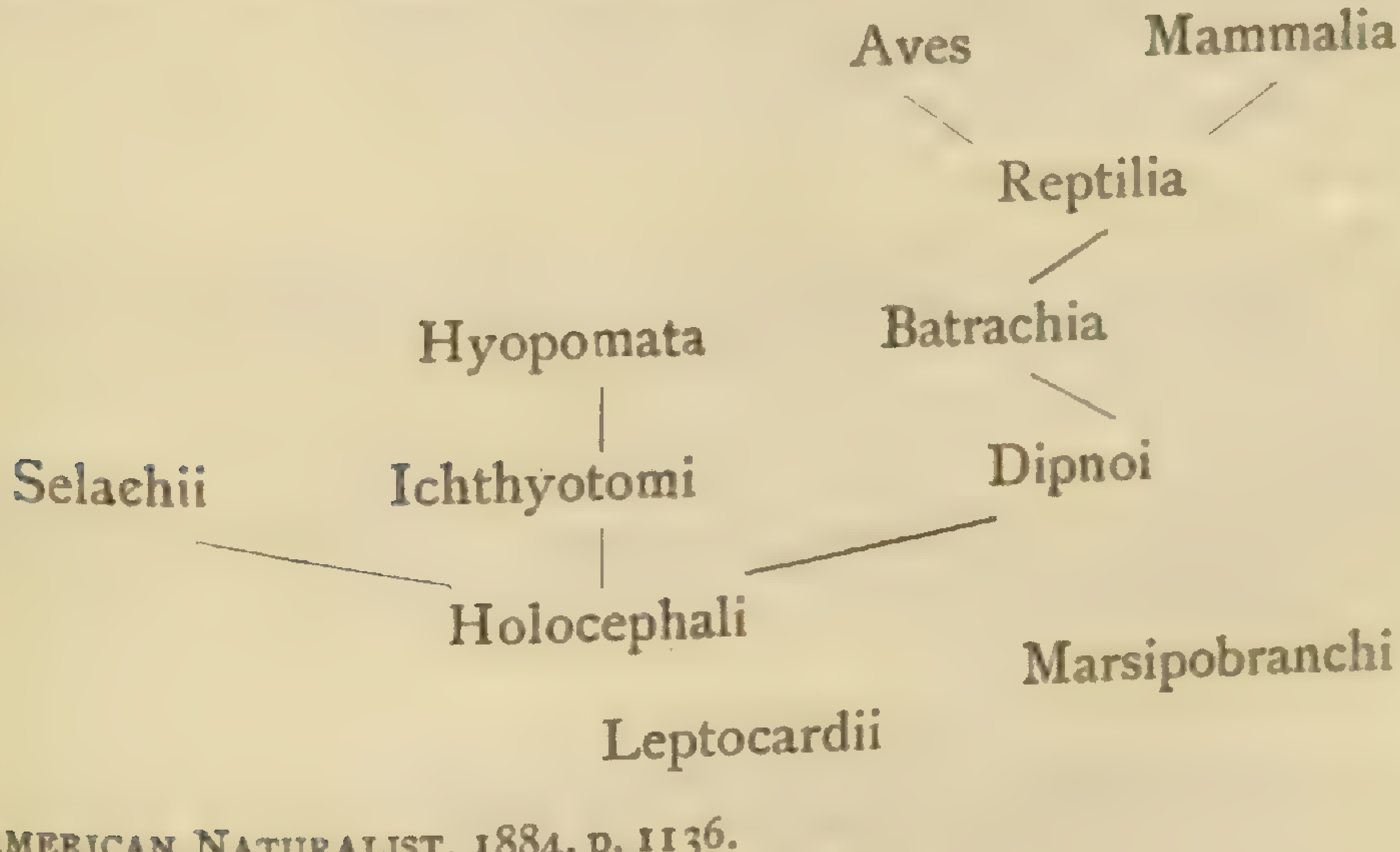
FIG. 4.—Dorsal vertebra of a species of Embolophorus, one-half natural size; right side; *a*, from front; *b*, from below. *ic*, intercentrum; *ca*, capitular rib articulation.

FIG. 5.—Astragalus of individual figured in fig. 4, one-half natural size; from below. *ca*, *ca*, facets for calcaneum; *na*, do, for navicular; *tib* 2, do, for bone of spur, or os tibiale. 5*a*, same bone from external or calcaneal border; *f*, fibular facet. 5*b*, same bone, proximal or fibular extremity.

FIG. 6.—Left posterior foot of *Clepsydrops natalis* Cope, superior side, and 6*a* inferior (plantar) side, two-thirds natural size. *as*, astragalus; *ca*, calcaneum; *na*, navicular bone; *cu*, cuboid; *enc*, *mc* and *ecc*, entocuneiform, mesocuneiform and ectocuneiform bones, respectively, I, II, III, IV, V, metatarsals. In this specimen the calcaneum is displaced, being turned backwards, so as to present its two astragalar facets (*asf*) anteriorly.

—*E. D. Cope.*

NOTE ON THE PHYLOGENY OF THE VERTEBRATA. — As my researches have now, as I believe, disclosed the ancestry of the mammals,[1] the birds,[2] the reptiles, and the true fishes,[3] or Hyopomata, I give the following phylogenetic diagram illustrating the same. This will only include the leading divisions. The special phylogenies of the Batrachia[4] and Reptilia,[5] and some of the Mammalia[6] have been already given.



[1] AMERICAN NATURALIST, 1884, p. 1136.
[2] Proceedings Academy Philadelphia, 1867, 234.
[3] Proceedings American Philosoph. Society, 1884, p. 585.
[4] AMERICAN NATURALIST, 1884, p. 27.
[5] Proceedings American Association for the Advancement of Science, XIX, 1871, 233.
[6] Proceedings American Philosophical Society, 1882, 447; AMERICAN NATURALIST, 1884, p. 261 and 1121; Report U.S. Geol. Survey W. of 100th Mer., G. M. Wheeler, 1877, IV, II, p. 282.

The Mammalia have been traced to the Theromorphous reptiles by the Monotremata. The birds, some of them at least, appear to have been derived from the Dinosaurian reptiles. The reptiles in their primary representative order, the Theromorpha, have been probably derived from the Rhachitomous Batrachia. The Batrachia have originated from the sub-class of fishes, the Dipnoi,[1] though not from any known form. I have shown that the true fishes or Hyopomata have descended from an order of sharks,[1] the Ichthyotomi, which possess characters of the Dipnoi also. The origin of the sharks remains entirely obscure, as does also that of the Marsipobranchi. Dohrn[2] believes the latter class to have acquired its present characters by a process of degeneration. The origin of the Vertebrata is as yet entirely unknown, Kowalevsky deriving them from the Ascidia, and Semper from the Annelida.

It is now possible to determine the nature of the evolution of the greater number of the vertebrata, by resolving the difficult problem of distinguishing primitive from degenerate types. By degeneration I understand loss of parts and organs which subserve what would be usually called animal vitality, as distinguished from vegetative life. Preëminent among these must be regarded varied powers of movement, which give the greatest opportunity for the exhibition of intelligence. *Loss of parts without complementary development of other parts is the usual form of degeneration.*

Among the true fishes there are several examples of degeneration. Among Physostomi the marine eels (order Colocephali) exhibit this in their skulls and fins, the final degradation being reached by the deep-sea form, the Eurypharyngidæ. In Physoclysti, the group with abdominal ventral fins descended through the Hemibranchi to the very degraded type of the Lophobranchi. The group with pectoral ventral fins, especially the Percomorphi, present us with a degraded type of the Plectognathi. The descent commenced in the suborder Epilasmia (Chætodontidæ, Teuthyidæ, etc.).

The Batrachia are almost entirely a line of degradation. It is now quite safe to say that the Trachystomatous order (Sirenidæ) is a degraded, and not a primitive type.

The lines of Reptilia which terminated in the existing orders is a line of degradation. In comparison with the Theromorpha, the Crocodilia are degraded, and the Lacertilia are still more so. This latter order displays within itself the most remarkable number of degraded forms, as I can agree with Dr. Boulenger in calling them. Among snakes, the Typhlopidæ and their allies are a degraded type, but the order displays an ascending scale on the whole. Two extinct orders of Reptilia show ascending

[1] Proceedings American Philosoph. Society, 1884, p. 585.

[2] Der Ursprung der Wirbelthiere u. d. Princip des Functionwechsels. Von Anton Dohrn, Leipsic, 1875, p. 32.

lines, viz., the Dinosauria and the Pterosauria, one or both of which terminated in the birds.

The birds appear to form an ascending series, with few or no exceptions.

The line of the Mammalia is mainly ascending. Probable exceptions are the Edentata, the Sirenia and the Cetacea.—*E. D. Cope.*

The Permanence of Ocean Beds.—Rev. O. Fisher publishes a letter in the *Geological Magazine* for September, in which he strongly supports the doctrine of the permanency of the ocean beds, closing as follows:

"Extensive changes of level seem to me to be the most difficult to account for of all the phenomena of geology. And the greater the changes, the greater the difficulty. The permanence of the respective areas seems therefore to involve less difficulty than their interchange. I published in *Nature* (Jan. 12, 1882), a suggestion to account for the origination of ocean basins. It is rather remarkable that the first and only allusion to it which I have seen has just now come from New Zealand in Dr. Haast's address at Canterbury College. Accepting Professor Darwin's theory that the moon broke away from the earth more than fifty million years ago, I think the ocean-basins may be the scar that was formed, and that the basement rocks of continents are fragments of the crust which had already solidified, and which were left behind. It has since occurred to me that the archæan rocks may be the veritable remains of it. I would refer to my published article for the details of the grounds on which I think this theory plausible. Dr. Haast uses rather too strong an expression in saying that I have attempted to prove it. It is probably incapable of proof, even if true."

Systematic Position of Lepidodendron, Sigillaria and Stigmaria.—According to the Journal of the Royal Microscopical Society for August, B. Renault maintains his previous view as to the relationship of these fossil plants against the objections of Williamson and Hartog. He considers that those Sigillariæ which can be determined with certainty belong to the Gymnosperm type, while the species of Lepidophlois have the characteristics of Lycopodiaceæ. Stigmariæ must be regarded partly as rhizomes of Gymnosperms; the anterior portions must have had only leaves with monocentric vascular bundles, the anterior part, after the fall of the leaves, only adventitious roots with tricentric vascular bundles; while in the middle were both roots and leaves. This may serve to explain the conflicting descriptions of various writers.

Geological Notes.—*General.*—The German Expedition has brought back the information that the island of South Georgia is composed of clay slate. This was not only found in situ, but taken from the débris brought down by the glaciers from the in-

terior. Varieties of quartz were interspersed in some places, and the rock contained a little iron, insufficient to affect the needle. The mountains are from two to three thousand metres in height. ——Dr. Carl Ochsenius, of Marburg. discusses, in a recent number of the *Geological Magazine*, the origin of metalliferous deposits, and states that his conclusions, as evidenced by extracts from the Journal of the German Geological Society, August, 1881, agree substantially with those arrived at by Professor Joseph Le Conte, and put forth in the *American Journal of Sciencе*, July 1883. To the words of the latter, "thus then subterranean waters of any kind, but especially alkaline, at any temperature, but mostly hot, circulating in any direction, but mainly upcoming, and in any kind of water may, but mainly in open fissures, by deposit form metalliferous veins." Dr. Ochsenius would add, "if they contain sufficient quantities of ores in solution," since many alkaline and saline springs and waters form no metalliferous deposits. He says, "Metalliferous deposits are in fact constituted of metallic particles, extracted from rocks by mother liquors, either with or without the operation of carbonic acid, and accumulated in fissures, cavities, or depressions. Mineral springs found in many metalliferous regions evidence the former activity of mother liquors."——Mr. W. T. Blanford states that it appears doubtful if the sedimentary formations of India can be accurately classified by means of the European subdivisions, and that he believes that the European classification can only be applied as an artificial scale or measure of comparison. He advocates the union of the Cambrian and Silurian, and considers the Devonian-Carboniferous-Permian as forming a second main division of Palæozoic. "Permian" does not occur in Asia. In the Indian Salt Range section, the upper series of the Carboniferous or Productus limestone series contains more Triassic forms than the Magnesian limestone of Europe. The Rhætic he considers as the upper member of the Triassic system, and advocates the Tertiary classification recommended by several German and Swiss geologists, viz., the union of the Oligocene with the Eocene, and the grouping of all the higher strata as Neogene or Mollasique.——The Permian (as commonly understood) has recently been roughly handled by the Rev. A. Irving, who shows that the Bunter and Mergel-Schiefer are Triassic, and are so regarded by German geologists, while the remainder of the so-called Permian, consisting of the marine Zechstein and the Rothliegende (a fresh water and land-formation with included eruptive rocks, parallel with the Zechstein) form the Dyas of the Germans. This Dyas may well be grouped with the Carboniferous.

Jurassic.—The stratigraphy of the middle Jurassic to the east of the Paris basin is elucidated by Wohlegemuth in a separate issue of the Academy of Sciences of Nancy. The middle and upper Bathonian, Callovian with *Ammonites athleta, anceps*, and *macrocephalus*, Oxfordian, Corallian with *Diceras arietinum* and

Cidaris florigemma, and the lower Kimmeridge or Astartian are described.

Cretaceous.—A neuropterous insect (*Æschna flindersiensis*), two trilobites and five molluscan species, including an Avicula and a Modiola, have been described by Dr. H. Woodward and W. H. Hudleston from the Cretaceous of Australia (*Geol. Mag.*, August).

Pleistocene.—Our knowledge of the glaciers of Europe is further increased in a paper by Edward Richter, in the zeitschrift of the German Alpine Club, entitled, "Observations on the Glaciers of the Eastern Alps, (I) the Obersalzbacher Glacier."——The Neues Jahrbuch für Mineralogie, Geol. and Palæon., 1884, notices the work of J. Partsch upon the ancient glaciers of the Carpathians and Central Germany, and that of A. Penck upon the glaciation of the German Alps, their causes, periodical retreat, and influence over the topography of the region covered by them. Penck divides the ice-period in the neighborhood of Innsbruck into six periods, concluding with the erosion of the Valley of the Inn, the formation of ravines on the terraces, and the deposition of moraines in them.——The same issue notices an account by Sr. Pereira Cabral of the superficial deposits of the basin of the Douro, around Oporto.

MINERALOGY.[1]

Leucite from Lower California.—The history of leucite is very interesting. Some thirty years ago Humboldt made the general statement that leucite occurred nowhere outside of Europe. Curiously enough, until within a few years this statement held good. In 1874, however, Vogelsang found it in an Asiatic basalt, and, in 1876, Zirkel announced its discovery in Wyoming Territory, U. S.

Although the leucite was invisible to the naked eye, Zirkel's discovery was regarded so important that the locality was named by the U. S. Geological Survey the *Leucite Hills*. An interesting commentary on the influence of modern science is furnished by a name so given.

Another extra-European locality for leucite is now announced by Von Chrustschoff[2] who finds it in a lava in the vicinity of the volcano "Cerro de las Virgines" in Lower California. The rock consists of an ash-gray ground-mass sprinkled with rounded spots of brownish-black obsidian or glass, and with light specks of leucite. These light specks are shown by a lens to have a rounded octagonal outline. Augite and olivine also occur porphyritically, and in the grondmass plagioclase, magnetite, nephe-

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Philadelphia.
[2] Min. u. Petrograph. Mitth., 1884, vi, 160.

line, mica, glass, and perhaps melilite can be found by the microscope.

The leucite is remarkably clear and fresh, and shows in polarized light the well known twinning structure, even better marked than in the leucite of the Vesuvian lavas or of the Laacher-See. While generally in rounded masses, the smaller individuals are often clearly octagonal in outline. The microscope shows the leucite to contain many inclusions, among which are augite, apatite, olivine, plagioclase, magnetite, nepheline and glass inclusions and bubbles.

Leucite has as yet never been found in rocks of pre-Tertiary age.

ENARGITE FROM MONTANA.—An arseniferous copper ore from Montana has been examined by Mr. Wm. Semmons,[1] who has found in it crystals of a mineral resembling enargite. The crystals are rare and small. They show prismatic and pinacoidal planes, the macro- and brachydomes and the basal pinacoid, and are apparently orthorhombic. They are highly striated, like stibnite, and cleave into little rhombic prisms. H = 2.5. Spec. grav. = 3.92. Soils the fingers. Color lead-gray when freshly broken, tarnishing on exposure, and then resembling blende. Streak black. Before the blowpipe it decrepitates and exfoliates into worm-like threads like vermiculite, and gives reactions for sulphur, arsenic and copper.

Composition: mean of two analyses:

Cu	As	S	SiO_2	Fe	
45.78	18.65	31.30	2.50	.80	= 99.03

As the hardness, the cleavage and the blowpipe characters differ from typical enargite, although the composition is the same, it is possible that this is a distinct species falling among such other sulph-arsenites of copper as famatinite, clarite, luzonite and guayacanite. It is desirable that crystallographic measurements should be taken.

LAZULITE FROM GEORGIA.—The beautiful lazulite occurring at Graves mountain, Lincoln county, Georgia, has long been known, but has until now not been investigated optically. It is in fine sky-blue crystals often over an inch in length and in width. Von Lasaulx[2] of Bonn has recently examined it optically. Fine pleochroism was noticed, the crystal being colorless in one direction of elasticity, and sky-blue in the two others. The optic axes lie in the plane of symmetry, their divergence in air being 110°. The angle between the bissectrix (negative) and certain known planes is also given. The microscope showed that the lazulite

[1] *Mineralogical Magazine*, 1884, VI, No. 27, p. 49.

[2] Sitzungsber. der niederrhein. Ges. für Natur. und Heilk. December, 1883, p. 274.

was not homogeneous, being traversed by rutile and by other undetermined substances.

MINERALOGICAL NOTES—Professor Bonney[1] publishes an account of a case of the replacement of quartz by fluor spar. The rock in which it occurs is a mixture of red felspar, fluor spar and tourmaline, and has been named "Trowlesworthite"[2] by Mr. Worth. It is believed that the rock has been formed from granite through the replacement of quartz by fluor spar. This is an unusual substitution.

Professor W. P. Blake[3] has found *columbite* associated with cassiterite, albite and mica in several of the coarse granite veins which traverse the mica schists of Pennington county, Dakota. One mass of columbite was two feet long by twenty inches wide, and must have weighed a ton. In the cavities in the columbite he found a beautiful yellow powder in pellets and pill-like balls, consisting of nearly pure hydrous uranium oxide.

Garnet is reported by H. Louis[4] as occurring in the form of an igneous dyke in the province of Catalonia in the Pyrenees. The dyke varies in thickness from two to five and a half feet and is vertical. It is made of pure garnet free from admixture of other minerals.

The discovery of *herderite* at Stoneham, Maine, described by Mr. W. E. Hidden[5] about a year ago, and analyzed by J. B. Mackintosh, was of considerable interest. It had previously been found only at Ehrenfriedersdorf, Saxony, where it was very rare. In a recent note[6] Professor A. Wiesbach gives the results of a comparative chemical examination of the Saxon and Maine herderite, made at his suggestion by Dr. C. Winkler. These investigations showed remarkable discrepancies between the herderite from the two localities and also between the analyses of Mr. Mackintosh and himself. It was therefore desirable to re-examine the mineral, and Dr. F. A. Genth,[7] of the University of Pennsylvania, undertook a new analysis, with the result of confirming that of Mr. Mackintosh and disproving those of Dr. Winkler. The latter is shown to have employed incorrect methods of analysis, thus losing the fluorine and part of the glucina. Dr. Genth states that "there can be very little doubt that the Ehrenfriedersdorf and Stoneham mineral are identical in composition."

[1] *Mineralog. Magazine*, 1884, VI, p. 48.
[2] Trans. Royal Geolog. Soc. of Cornwall, Vol. X, p. 177.
[3] *Amer. Jour. Sc. and Arts*, November, 1884, p. 340.
[4] *Mineral. Magazine*, July, 1844, p. 46.
[5] *Amer. Journ. Science*, XXVII, 135.
[6] Neues Jahrb. d. Miner., 1884, II, 134.
[7] Proc. Amer. Philos. Soc, Oct. 17, 1884.

BOTANY.[1]

NOTES ON THE STRUCTURE OF THE FLOWERS OF ZYGADENUS GLAUCUS NUTT.—The plant is found in low prairie lands near Dayton; it arises from a coated bulb, the last one or two leaves of which subtend buds that are to form the bulbs of next year. In addition to these bulbs the plant sometimes puts forth a short stem scarcely an inch long at the end of which a bulb and roots are developed. This stem originates in the parent bulb, but just where, I neglected to determine. The flowers are borne in panicles, are nearly erect, and permit the insect visitors to walk easily about on the leaves of the greenish-white perianth, sipping the excretion from the obcordate green glands (Fig. 3). The excretion had a disagreeable taste, and was not sweet. The open nature of the flower would suggest the visits of chiefly diptera, and such were the only visitors I saw. In the bud, stamens and styles are erect. The anthers are heart-shaped, confluently one-celled and extorse. The three outer stamens mature first, then the three inner stamens, recurving until the anthers face the glands (Fig. 1). After dehiscence the stamens again assume an erect position and the styles begin to grow in size and recurve until the stigmas assume the positions first held by the anthers (Fig. 2). There is no provision made for the protection of the gland excretion. The first rain could wash it away. All insects can readily get at it. But the disagreeable taste is sufficient to keep away most unwelcome visitors. Bees seem to evade it for better plants and probably the taste of the nectar adapts this plant as perfectly to flies as the more complicated structures do to higher insects. The unsightly colors are also noticeable in this respect.—*Aug. F. Foerste, Granville, Ohio.*

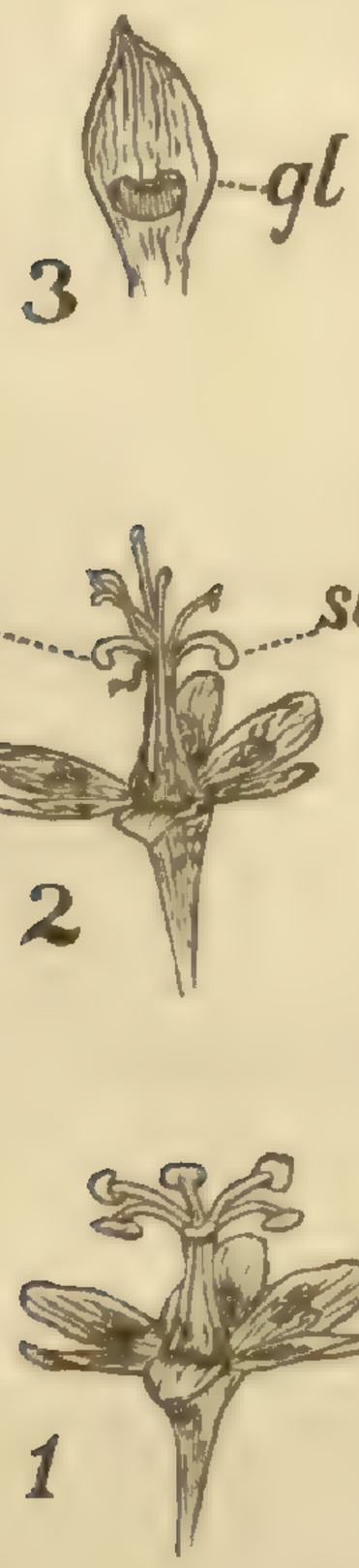


FIG. 1.—Male state of flower, natural size, with the stamens recurved. FIG. 2—Female state of flower, the stamens now erect, and the three stigmas, *st*, recurved. FIG. 3.—Upper surface of a perianth leaf (slightly enlarged) showing a gland at *gl*.

CONCERNING THE MANNER IN WHICH SOME SEEDS OF GRASSES BURY THEMSELVES IN THE SOIL.[2]—You are doubtless all more or less familiar with the experiments of Francis Darwin and a few others before him on the power of seeds of Stipa, Erodium, Heteropogon, Avena, and other plants to bury themselves beneath the surface of the soil. Mr. Darwin's account is the best, and can be found in the transactions of the Linnean Society for 1876

[1] Edited by PROFESSOR C. E. BESSEY, Lincoln, Nebraska.
[2] Read before the Botanical Club of the A. A. A. S.

When dry, the awns of these seeds or fruits twist about, leaving a considerable portion of the untwisted part of the awn at the tip spread out at nearly right-angles to the rest of the awn. If wet, the awn untwists and becomes straight. The apex is sharp, and is usually supplied with short, stiff hairs, which act as barbs to a spear, and help hold all that is gained as the apex pushes or bores forward. These seeds usually fall to the ground among straws, stubble, and more or less rubbish. If the awn is held in place, the motion takes place in the grain.

Some years ago in repeating this experiment, I placed a box of earth full of small sticks or straws every inch or so over the surface. This was to act as stubble, and by holding the awn, help the seeds to penetrate the ground. The seeds worked well, some of them (*Stipa spartea*) boring down two inches to the bottom of the box.

Later I tried some in a box of earth without any straws or sticks, and was surprised to find that they all but one, in fifty or more, had no trouble in penetrating the soil. The seeds of some species penetrate the skins of sheep and dogs and become quite troublesome. I have recently been studying the grain of three species of grass with reference to this subject.

After dry weather where some tall oat-grass (*Arrhenatherum avenaceum*) had gone to seed before it was cut, the land in places had cracked in drying. There was considerable litter among the plants on the ground. It was very interesting to see that the seeds had nearly all twisted their way down under this litter of straws, dead leaves and other rubbish. Every little hole and crack in the dried earth was stuck full of these seeds with the base end down bringing the embryo farthest into the ground. Some of the seeds had gone down an inch or so into the cracks.

On the last of July we had some days of wet weather which caused the cracks in the soil to close up against the seeds; the pattering drops of rain scattered more or less earth into the holes and cracks over the seeds and they began to grow freely.

Large quantities of seeds of *Anthoxanthum puelli*, a species of small sweet vernal, behaved just as well as those of oat-grass. They found the cracks and crevices; the litter served as a mulch; the seeds started to grow. In a thin place on the lawn some seeds of *Danthonia spicata* were observed. They bored down as well as those of the two former plants, but in this case large numbers of ants were busy in their excavations, thus making small hills, usually not more than an inch high and three inches in diameter. Numerous seeds of Danthonia were already sprouting and the young plants were coming out of the fresh earth where they had buried themselves or had been buried by the ants. Numerous mole hills in the vicinity might also have served as newly prepared ground for these seeds, had the plants grown just there.

A few weeks ago, some boxes were half-filled with good garden

soil. The surface seemed quite even, though there were some small lumps half an inch or more in diameter, and a few irregular, narrow depressions here and there. On the soil were scattered in the several boxes, seeds in the chaff of the three grasses named. There were no artificial obstructions placed in the soil, which was alternately wet and dried quite a number of times, till nearly all the seeds disappeared below the surface and some of them, even when the surface was quite dry, began to send up green leaves. Thus we see that even the weak and short twisting awns of some grasses are of use in covering the seeds with soil.—*Dr. W. J. Beal, Agricultural College, Mich.*

NEW SPECIES OF NORTH AMERICAN FUNGI (*Continued*).—*Phyllosticta leucothöes.*—Apical portion, or often the entire upper half of the leaf discolored, rusty brown, the discolored part distinctly limited. Perithecia globose 150–200μ in diam., few and scattered, buried in the substance of the leaf, their apices slightly prominent above, but covered by the epidermis; spores ovate-oblong, 15–21 × 6–7μ, granular or with 2–3 nuclei. Differs from *P. terminalis* E. and M., to which it bears a general resemblance in the different color of the affected part and in its much larger spores. On leaves of *Leucothöe acuminata.* Green Cove Springs, Fla., January, 1884.

Phyllosticta sinuosa.—Spots orbicular, 1.5–6^{mm} (mostly 2–3^{mm}), reddish-brown, becoming nearly white with a distinct raised, reddish-black border; perithecia epiphyllous, scattered, lenticular (150μ) mostly near the margin of the spots; spores oblong or clavate-oblong, hyaline, 3½μ (undeveloped) ?–15μ and 1½–2μ wide. On leaves of *Olea americana.* Green Cove Springs, Fla., February, 1884.

Phyllosticta corylina.—Spots red-brown, round (2–5^{mm}) or oftener coalescing and continuous along the edge of the leaf, perithecia brown-black, erumpent, lenticular, amphigenous (90–120) on very short basidia; spores subhyaline, oblong, mostly with a nucleus in each end, 12–15 × 6–7μ. This appears to differ from *P. coryli* S. and S. and from *P. corylaria* Sacc. in its larger spores and the different character of the spots. On leaves of *Corylus americana.* Newfield, N. J., August, 1884.

Phyllosticta apocyni.—Epiphyllous on brown, round definitely limited spots (1–2^{mm}), with a slightly raised narrow border; perithecia subglobose, erumpent, mostly in the center of the spots, 75 dia n., spores globose or ovate, 7–9μ with granular contents, larger than those of *P. asclepiadearum* West. On leaves of *Apocynum cannabinum.* July.

Sacidium polygonati. — Perithecia flattened, globose or elliptical, 200–230μ in diameter; astomous, of compact, subradiate cellular structure; spores subglobose or subangular by compression, 5–7μ. On dead stems of *Polygonatum giganteum.*—*J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

THE DEATH OF GEORGE BENTHAM.—This eminent man, whose name is familiar to every botanist, died on the 10th of September at his home in London, England, at the advanced age of eighty-four years. He was born at Plymouth, September 22, 1800. The years from 1814 to 1826 were spent in southern France, a result of which was his first botanical publication, a Catalogue of Plants Indigenous to the Pyrenees and Bas Languedoc, issued in 1826. In 1854 his great herbarium and library were given to Kew, and here he worked assiduously upon genera and orders of plants, the results of which appeared from time to time in the form of unrivaled monographs. The greatest work of his life was that upon the Genera Plantarum, began in 1862 and completed in 1883, the joint product of Mr. Bentham and Sir Joseph Hooker.

NOTICE.—CHANGE OF ADDRESS.—The editor of this department having accepted the chair of botany and horticulture in the University of Nebraska, should hereafter be addressed at Lincoln, Nebraska.

BOTANICAL NOTES.—Dr. Vasey has again placed the botanists of the country under obligations to him by bringing out a thick pamphlet entitled The Agricultural Grasses of the United States. A proper notice will be given of it in the future, but we must stop long enough to commend this as a sample of the kind of publications which are creditable to the department of agriculture. Unfortunately many of its publications have been far from creditable.——In recent numbers of the *Gardener's Chronicle* Thos. Meehan publishes a valuable article on the fertility of hybrids, from which we hope to be able to make extracts at an early date. ——In the same journal for September 27, W. G. Smith gives an account of the growth of the little fungus *Schizophyllum commune* upon the cut edge of ensilage in a silo. This is surely an odd place for it to grow, but it sounds oddly to learn that "the fungus is a common one in the tropics, rarely spreading into temperate regions." It is, as every collector well knows, one of our most common fungi the year round, growing upon sticks and timber everywhere.——The Ninth Annual Report of the Montreal Horticultural Society contains an interesting paper by Professor Penhallow on the trees and shrubs of northern Japan.—— The September *Torrey Bulletin* contains a paper by J. H. Redfield, giving the known localities of *Corema conradii*, from which it appears that it occurs upon the (1) New Jersey pine barrens, (2) upon Long Island, (3) at Plymouth, Mass., (4) Bath, Me., (5) Isle au Haut, Me., (6) Nova Scotia and Newfoundland, (7) Shawangunk mountains, N. Y.——In the same number is a convenient list, by A. F. Fœrste, of the changes in nomenclature as they occurred in Gray's Synoptical Flora, Vol. I, part II. There are about a hundred changes, but it does not follow that "about one-fourth of

the species are to receive different names," as the writer of the paper remarks, for by a strange slip of memory the volume is said to enumerate "less than 400 monopetalous [sic] species from Caprifoliaceæ to Compositæ inclusive." The Compositæ alone include nearly four times that number!

ENTOMOLOGY.

GREAT SWARMS OF A PSEUDO-NEUROPTEROUS INSECT IN JAPAN.—On the 17th February of this year (1878), at about 7 o'clock A.M., this curious kind of insect (in the bottle) was seen at Yunosawa, in the district of Kameda, near Hakodate port, flying in swarms of so great numbers that for the distance of about four or five chios (1440 to 1800 feet) it seemed quite dark. At this time they were very small and looked like gnats or mosquitos. But about one hour afterwards they seemed to grow as big as a small sort of fly, and each pair copulated together for several hours, and then they all fell down dead.

This insect was also seen on the 29th December last year (1877). The residents of that place stated that they had never seen any before there, even in summer, and they considered it very strange that such insects were found there in the season of snow, especially during this severe winter.

Yunosawa is situated in a small valley. A small stream runs through this valley, and at its bank there is a lime manufactory, besides only one farmer's house, and a few rice fields, also a hot spring in this valley.

I have the honor to request you will be kind enough to examine the accompanying specimens of some curious insects lately found at Yunosawa, and shall be glad if you can give me some information regarding them.—*Aritake Yutaka, Kaitaku Wosakwan.*

[The insects were sent to Dr. Hagen who pronounced them a species of Capnia.—*Ed.*]

THE LARVAL STAGES OF MAMESTRA PICTA.—In the middle of September, 1876, the caterpillars of this moth did extensive injury to the ruta bagas on the farm of the Massachusetts Agricultural College at Amherst; eight years previous they also destroyed the leaves of this vegetable as well as the beet. The following descriptions may be of service as data for a comparative study of the early stages of the Noctuidæ:

Larva before the 1st moult.—Length 4$^{mm.}$ Head as wide as the body, pale-greenish; body pale-greenish with a double dark livid dorsal stripe divided by a pale median line; three lateral dark stripes, of which the uppermost is the narrower; five pairs of abdominal feet, first pair one-half the size of the fourth pair. Body well tuberculated, being smoother in the adult.

Larva after the 1st moult.—Length 7$^{mm.}$ Markings much as in the full-grown larva, deep yellow with a broad black dorsal band,

sometimes entire and sometimes divided by a median pale line. A lateral area marbled with transverse short black and white lines, and with a row of conspicuous black spots. A row of dark spots down on the sides. Head reddish testaceous; abdominal feet reddish.

Larva after 2d or 3d moult.—Length 25$^{mm.}$ Markings as in the full-grown caterpillar, straw-yellow, with a broad dorsal black stripe, and a broader dark lateral stripe; this stripe interrupted by transverse rune-like white markings breaking up the band into similar black runes.

A caterpillar moulted under my eyes; the sides of the head fell off away from the rest of the body, and in an instant the anterior half of the body was pulled out of the old skin; I do not understand where it went to; then in a minute more, stopping occasionally to rest, it withdrew itself from the remainder of its old skin, holding on by its hind legs until they were extricated from the cast skin. The whole process was but the work of one minute. It was but little larger than previous; the prothoracic segment was less spotted and the head much paler than before. By 4 P. M., or about four or five hours after, the head was red-colored, and the six prothoracic black spots had appeared.—*A. S. Packard.*

THE BEES, WASPS, ETC., OF LABRADOR.—Several years ago I named the bees and a few other Hymenoptera which I collected in Labrador during the summers of 1860 and 1864. The specimens are now in the Museum of the Peabody Academy of Science, at Salem, Mass. Of the species of Bombus by far the most common species was *B. lacustris* Cresson, which occurred at Henley harbor, Square island, Sloop harbor and Strawberry harbor; *B. nivalis* Dahlb? occurred at Caribou island, Straits of Belle Isle; *B. frigidus* Smith, occurred at Square island and Hopedale; it also was brought from Nulato, Alaska, by Mr. W. H. Dall; *B. kirbyellus* Curtis, an arctic species, occurred at Sloop harbor and Hopedale. Of the genus Vespa, *V. maculata* flew aboard our vessel at Little Mecatina island, while a nest of *V. norvegica* Fabr. occurred under the turf at Caribou island; it is identical with specimens from Alaska (Dall). *Formica herculanea* was common on the Labrador coast, and is also frequent in northern Alaska. Two species of Sirex occur; besides a common one at Caribou island, a bluish-green species occurs at Hopedale; the stout spine is concolorous with the body, while the legs are yellowish.—*A. S. Packard.*

DANGERS FROM THE EXCREMENT OF FLIES.—The Journal of the Royal Microscopical Society for August, prints an abstract of B. Grassi's experiments which show that flies are agents in the diffusion of infectious maladies, epidemics, and even parasitic diseases.

On a plate on the table of his laboratory he placed a large number of the eggs of a human Nematode parasite (Trichocephalus).

After a few hours, he found, on some white sheets of paper hanging in the kitchen, the well-known spots produced by the excreta of the flies, and on a microscopical examination of these spots, several of the eggs of the parasite were found in them. Some flies coming into the kitchen were now caught, and their intestinal tract was found quite filled with an enormous mass of fæcal matter, in which the presence of eggs of Trichocephali were detected. As it was practically impossible to keep all alimentary substances from contact with these flies, it follows that the chances of Dr. Grassi and his family being infected with Trichocephali were very great. As a matter of fact, the experiment was tried with non-segmented eggs of this worm. Another experiment was in the same direction. Dr. Grassi took the ripe segments of a *Tænia solium* (which had been in spirits of wine), and broke them up in water, so that a great number of the tapeworm's eggs remained suspended in the fluid. The flies came to the mixture, attracted by the sugar, and in about half an hour the ova of the tapeworms were to be found in their intestines and in the spots. Had these eggs been in a recent and living state, they would doubtless have been just as easily transported. To those who care to try these experiments, it is suggested that lycopod powder, mixed with sugar and water, is a good material, as the lycopod spores are easily detected.

It is self-evident that if the mouth-apparatus of the fly will admit of the introduction of such objects as have been above noted, that there will be no difficulty in its admitting scores of the spores of many parasitic fungi, and above all of those belonging to the Schizomycetes, the possible cause of so much disease. Already Dr. Grassi has detected in fly excrement the spores of *Oidium lactis*, and the spores of a Botrytis, this latter taken from the bodies of silkworms dead of muscardine.

There arises, of course, the question of how far the active digestion of the intestines of the fly may not destroy the vitality of germs or spores thus taken in, but it would seem probable that in many instances the larger bodies swallowed may not serve as objects for assimilation, but may be got rid of as foreign bodies, and it will be borne in mind that the flies themselves fall victims to the growth of a parasitic fungus (*Empusa muscæ* Cohn), which is probably taken first into their own stomachs.

Origin of Bee's Cells.—Dr. Dönhoff urges objections to the views of Buffon, carried further by Müllenhoff, that bees' cells are due to pressure, pointing out that there is no relation between the forms of the cells and of the bees' bodies, and that he has observed a single female build a nest consisting of a number of six-sided cells; further, the difference seen in cells formed by bees and drones cannot be correlated with any differences to be found in the inhabitants; in the formation of the queens' cells by

other bees there is no pressure to produce the rhomboid pits; direct observation of the formation of a comb was not rewarded by any indications of pressure; no reasonable amount of pressure on the walls of cells seems to have any effect in altering their form.

The author thinks that Darwin has erred in supposing that the cells have at first the forms which they have later on, whereas this is by no means the case; at first there are nothing but rhomb-shaped spaces, the size of which is gradually increased. Compare also the statements made by Packard in "Guide to the Study of Insects," pp. 121–122, as to the way in which Polistes begins its cells.

Entomological Notes.—The Bulletin of the Brooklyn Entomological Society for October republishes Herrich-Schaffer's synopsis of the "families" of Lepidoptera, with the statement that the table "is not exactly accurate, as applied to our fauna, but it is so far correct that all save a few aberrant forms can be correctly referred by its means." It seems to us a great pity to reproduce an antiquated, in many respects artificial and misleading classification of the Lepidoptera, which may have been useful in Europe, but is not now provocative of good work in America. ——The same journal contains a report of the proceedings of the Entomological Club of the American Association Adv. Science, Philadelphia meeting. Dr. D. S. Kellicott read a paper on the ovipositing apparatus of *Nonagria subcarnea*. Mr. Mann, one of the chief editors of *Psyche*, proposed a combination of the entomological journals of America, a view we heartily advocate. A committee appointed to consider whether such a combination was advisable, reported adversely to any such scheme. We do not see why a well-conducted, responsible journal, well edited, free from crotchets, with articles and departments representing anatomical, systematic, biological and economic entomology, would not meet with support. Meanwhile it is comforting to learn that the American Entomological Society is "wealthy enough to publish everything in the way of long systematic papers presented to it, and the transactions would be the natural avenue for such works." We desire to add that the proceedings and transactions of this society have always been up to high-water mark; if we had no other periodicals, the transactions would worthily represent American entomological science—— The discussion regarding nomenclature introduced by Professor Fernald was noteworthy in some points. In the course of it, Professor Fernald expressed surprise that Hübner's Verzeichniss genera should be so generally ignored, though his genera were after a fashion described; Mr. Smith stating that Hübner's genera of Noctuidæ would not hold, Professor Fernald added that in the Tortricidæ "Guenee has just as many baseless genera as Hübner has." Mr. Smith discussed the secondary sexual character

of the Noctuidæ and Deltoidæ. Mr. Mann explained how Professor Barnard raised larvæ living in running water. He confined them in a glass tube, one end closed by a porous substance, the other fastened to a faucet. In this way a steady flow of water of any desired strength can be kept up. Dr. Horn stated that, in 1874, when working with Dr. Le Conte on the Rhynchophora, among all their material only a single specimen of *Aramiges fulleri* was contained, and that came from Montana. A year or two after, it was received from all parts of the country, and was dreaded as one of the worst hot-house pests. How did this species spread so suddenly over so large a territory? Professor Lintner had first found the insect in 1876. Professor Dimmock found it very troublesome in hot-houses, especially on roses.——The composition and properties of the light emitted by insects of the genus Pyrophorus forms the subject of a paper recently presented to the Paris Academy of Sciences by MM. Aubert and R. Dubois. The spectrum of the light, examined by the spectroscope, is very beautiful, but destitute of dark bands. When, however, the intensity diminishes, the red and orange disappear, and the green and yellow only remain.——The investigations of M. Carlet enable him to affirm that the poison-apparatus of the Hymenoptera is always composed of two distinct glandular systems, the one with a strongly acid, the other with a feebly alkaline secretion. These two systems unite at the sheath of the sting. The resultant venom is always acid. The action of this venom upon some animals, as rabbits, frogs and certain beetles, is slight, but the domestic fly and the flesh fly are killed immediately by it. The inoculation of a fly with the secretion of one of the glands does not produce death until after a considerable time, but death follows very quickly if the same fly is subjected to a second inoculation, this time with the secretion of the other gland.——M. J. Chatin has studied the basilar piece of the jaw of insects, a part which has been much neglected, yet one of considerable importance. In *Blaps producta*, this portion, which M. Chatin calls the submaxillary, is produced beyond the maxillary.——P. Kirbach (Archiv für Naturgeschichte) gives a description of the structure of the parts of the mouth in the Lepidoptera.——A correspondent writes us as follows: Cape San Antonio is the westernmost point of the island of Cuba. During the whole of the night of the 23d of August, 1884, the lantern of the lighthouse at that place was surrounded by a cloud of winged insects almost entirely of a bright-red hue, the presence of these causing the light to assume a decided red color; the wind was moderate and from the south-west; the sky was overcast. A few of these bugs have been sent to this city (New York) by Francisco Bautista, the keeper of the light, and identified as cotton-stainers (*Dysdercus sanguinarius* Stal). Though other similar insects have been observed to fly toward lights, this is the first time that

this one has been so reported. It is to be hoped that such dangerous action will not prove chronic with the brilliant and beautiful Hemiptera.——Professor C. V. Riley was awarded a gold medal by the Forestry Exhibition at Edinburgh, in October, for the collection of insects injuring forest trees sent out by the Entomological Division of the Department of Agriculture.

ZOÖLOGY.

THE MOLLUSCAN BODY-CAVITY.—The molluscan forms in general are unlike most of the other metazoan groups in having or seeming to have no body-cavity, the spaces between their organs being filled up with branched cells forming a parenchymatous mass. This fact has led the Hertwig brothers to subdivide the Metazoa above Cœlenterates into two groups, animals with a true body-cavity lined with epithelial cells, including annelids, arthropods and vertebrates, and animals with no such cavity, but with a pseudo-body-cavity of lacunar spaces among amœboid-shaped cells, including Polyzoa, rotifers, plathelminths and Mollusca. Zoölogists generally have been disinclined to accept the view that the parenchymatous tissues of the mollusk are at all comparable with the body-cavity of annelids, etc., and prefer to consider these body-spaces of the mollusks a vastly increased mesodermal mass that has encroached upon the true epithelial-lined body-cavity and greatly reduced its proportions.

It is a constant feature of true body-cavities that they stand in direct communication with the exterior through organs usually excretory in function but also often reproductive. In the Mollusca the pericardium is in direct communication with the exterior through the organ of Bojanus, the molluscan kidney. This has been observed and described in a very large number of Lamellibranchs. Cunningham has recently shown that the kidney in Aplysia[1] and in Patella[2] has openings into the pericardium. Sedgwick has shown the same for Chiton. It has, therefore, been suggested on many sides that in the molluscan pericardium we have the remains of a body-cavity, but shrunken here to very small dimensions. Upon this view the very characteristic form of the molluscan kidney and pericardium becomes intelligible.

In a paper by Von Ihring[3] we are informed that there is a further relation between the renal organs and the generative system which is of interest. We are taught that in the mollusks the genital organs are shut off from the renal system, and open to the exterior by a special duct directly continuous with the organ. This is very unlike the animals with a body-cavity, for in them the genital organs very generally are related to the body-cavity

[1] *Mitt. Zool. Stat. Neapel*, Vol. IV, p. 420.
[2] *Quart. Jour. Mic. Sci.*, July, 1883.
[3] *Zeitschr. f. w. Zool.*, XXIX, p. 583.

and to the renal organs. Von Ihring's studies show that in some mollusks there is a direct relation between the renal organs and the genital organs. In the lamellibranchs he found that the kidneys are paired pouches opening to the exterior by paired orifices, that the genital organs are likewise paired pouches, that there are three modes by which these open to the exterior:

1. By a distinct orifice distinct from the renal orifice of the same side. This is the common mode, and was observed by Von Ihring in Tridacna, Isocardia, Seripes, Cardium, Gastrochæna, Mya, Cosbicula, Donax, Psammobia, Venus.

2. By a distinct orifice situated upon the same papilla with the renal orifice of the same side, *e. g.*, Mytilus.

3. By an orifice directly into the renal pouch of the same side, *e. g.*, Modiola, Modiolaria, Mytilus, Yoldia, Avicula, Isognomon, Margaritifera, Pecten, Spondylus.

There is here then ground for supposing that the genital system as well as the renal system may have stood in relation with the pericardial cavity in the early molluscan forms.

Hubrecht[1] describing Proneomenia states that the duct from the reproductive organ runs straight through the pericardium, and is in communication with it, and that in Chætoderma there is also a communication between the generative and pericardial cavities, and that this is the remnant of a primitive condition, and is similar in its meaning to the condition of things in Patella and Fissurella where renal and genital system open on some papilla, while in most gastropods even this slight indication of a previous closer relation is lost.

The morphology of these organs has been recently further illuminated by Grobben,[2] who has just published a paper upon the renal and genital systems and body-cavity of mollusks. This paper contains many interesting and suggestive thoughts, but the important results as far as they concern my present purpose may be summarized as follows:

1. In *Sepia officinalis* there is a pair of kidney sacks, with epithelium strongly glandular where these occupy the region of the body where the hearts and main vascular trunks are situated, and these kidney sacks open to the exterior by proper papillæ. A ciliated opening leads into this kidney sack from a cavity lined with ciliated epithelium; this cavity contains the gill hearts, the aortic heart and the genital organs. The ovary is a ridge in this cavity formed of folds of peritoneal epithelium, and ova are developed from its cells. Eggs from it are caught up by the open end of an oviduct and conveyed through it to the mantle cavity.

2. In *Eledone moschata* the peritoneal space is not large as in Sepia, and does not surround the hearts, it is small and little

[1] *Proneomenia sluiteri, Quart. Journ. Micros. Sci.*
[2] Claus' Arbeiten, Vol. v, p. 179.

more than a reproductive organ, its walls being almost completely occupied by the folds which give rise to the ova. But it is most important to observe that a narrow tubular channel runs from it into the kidney sack opening, then by a ciliated mouth and lined with ciliated epithelium.

Grobben in his article states the obvious conclusions that this reproductive organ of the cephalopod is the remnant of a body-cavity, and that in the vast majority of existing Mollusca we have, as the sole surviving portion of the primitive body-cavity of the Mollusca, the pericardium, the renal organs and the genital glands.

Grobben promises a future paper with the details fully described and figured, upon the subject of this communication. It promises to be a most important contribution.

In the light of these facts it would seem that the separation of the Mollusca from the animals with true body-cavity, as is done by the Hertwigs, is not justified, for though their body cavity is at present insignificant, it would seem that this is due to the loss of the same and an early condition of greater likeness to the enterocœls rather than to an essential unlikeness reaching back to the earliest ancestor.—*Henry Leslie Osborn.*

Note on the Pelvis in Birds and Dinosaurs.—By the papers of Hulke[1] and Marsh[2] a new light was given upon the morphology of the pelvis in birds and dinosaurs. That part in birds previously considered as pubis was now the postacetabular part of this bone, the real pubis was seen on the "pectineal process" (Huxley). This preacetabular part of the pubis was called "pubis," the postacetabular portion "postpubis." This view seems generally adopted to-day.

I have recently had occasion to examine the pelvis of young chickens, quails and ducks, and I find that the "pectineal process" does not belong to the pubis; this process forms a part of the ilium. Bunge[3] has the same opinion, and lately this point has been discussed by Dollo.[4]

Notwithstanding that Dollo found correctly that the "pectineal process" belongs to the ilium, he homologizes it with the pubis, believing that this process was formerly distinct. "En effet, celle-cié dans un organe rudimentaire, pourrait être ossifiée *par usurpation* directement avec l'ilium" (p. 95).

Farther he considers the pubis and postpubis of the dinosaurs forming originally two distinct elements. "Il résulte de tent ce que nous verrons de dire que le *pubis* et le *post-pubis* seraient

[1] *Hulke, T. W.* Appendix to "Note on a modified form of Dinos. ilium hitherto reputed scapula." Quart. Journ. Geol. Soc., Vol. xxxii, pp. 364–366, Aug., 1876.

[2] *Marsh, O. C.* Princ. charac. of Am. Jur. Dinos. Pars. i, xii, *Am. Journ. Sci. and Arts*, Nov., 1878, Jan., 1879. *Marsh, O. C.* Odontornithes. 1880.

[3] *Bunge, Al.* Untersuchungen zur Entwicklungsgeschichte des Beckengürtels der Amphibien, Reptilien und Vögel. Dorpat, 1880.

[4] *Dollo, M. L.* Troisième note sur les Dinosauriens de Bernissart. Bull. du Mus. roy. de Belgique, Tome ii, 1883.

primitivement des éléments séparés et que, *seuls*, les Dinosauriens et les Oiseaux persideraient ce dernier" (p. 97). I can only agree on the last point with Dollo.

Sabatier[1] has figured the pelvis of a young *Casuarius galeatus*. In this specimen the line which separates the ilium and the pubis crosses the "pectineal process;" the upper half belongs to the ilium, the lower one to the pubis. This I think affords a solution to the problem.

The upper part of the "pectineal process" forming a part of the ilium, corresponds to the whole "pectineal process" of the Carinatæ and to that part of the dinosaurian ilium which articulates with the pubis; the lower part is homologous with the pubis of the dinosaurs, which has become quite rudimentary in the Carinatæ.

With this interpretation the researches of Miss Johnson[2] agree, though only partially, for she considers the pectineal process of the chicken as the pubis. She found in embryos of the chicken a well-developed preacetabular part of the pubis, which she homologizes with the pubis of dinosaurs. This is quite true for the lower and anterior part, but we can only detect in the upper part elements of the pectineal process, *i. e.*, elements of the ilium. A sharp line between the ilium and pubis at this time of development cannot be drawn, for both the ilium and the pubis consist of a single cartilaginous mass.

It is interesting to trace the development of the postpubis in the series of dinosaurians and birds. The oldest dinosaurs, as also the carnivorous forms, have no postpubis. In the Sauropoda it begins to appear (Camarasaurus, Mososaurus, Atlantosaurus), and in the Stegosauria it is well developed. In the Ornithograda it shows still a greater development; at the same time the pubis gets shorter; in the Ratitæ there is only a small part of the pubis to be seen; in the Carinatæ (whether in *all* is still a question) it is quite rudimentary, whilst the postpubis has become greatly developed.

	Carn. Dinos.	*Saurop.*	*Stegos.*	*Ornithop.*	*Rat.*	*Carin.*
Pubis	well developed.	well devel.	well devel	well develop. Reduction beginning (Iguanodon).	very small lower part of pect. proc.	quite rudimentary.
Postpubis . .	wanting.	begins to appear.	well devel.	well devel.	well devel.	very much developed.
Ischium . .	larger than postpubis.	larger than postpubis.	a little larger than postpubis.	larger than or equal to postpubis.	equal to or smaller than postpubis.	smaller than postpubis.

[1] *Sabatier, N.* Comp. des Ceint. et des Membres antèr. et postér. dans la série des Vertébrés. Montpellier, 1880. Mém. de l'Acad. des Sciences et Lettres (Sect. des Sciences, tom. IX, 1880, Pl. VI, Fig. 1.

[2] *Johnson A.* On the development of the pelvic girdle and skeleton of the hind limb on the chick. Quart. Jour. Micr. Soc., Vol. XXIII, new series, Pl. XXVI and XXVII, 1883.

From this table it will be seen that the carnivorous Dinosaurs stand in *no direct* genetic connection with the birds. There is no "postbubis" in the carnivorous Dinosaurs; these forms seem to become extinct in the Cretaceous, leaving no descendants.

In the herbivorous Dinosaurs and especially in the ornithopod-like forms we must seek for the ancestry of birds, and evidently that of the Ratitæ, the Carinatæ being thus considered as descending from the Ratitæ. It is not at all evident that Archæopteryx belongs in the carinate line as Dames believes.—*Dr. J. G. Baur, Yale College Mus., New Haven, Conn., October, 1884.*

Thomasomys, a new subgeneric type of Hesperomys.—We have been greatly interested in the progress of Mr. Oldfield Thomas's studies of South American Muridæ—a difficult group on which we think this author has succeeded in throwing much needed light. His latest paper, a valuable one upon Jelski's Peruvian collection (P. Z. S. June 17, 1884), divides the unwieldy genus Hesperomys into the following groups: Rhipidomys, Oryzomys, Calomys, Vesperimus, Onychomys, Scapteromys, Phyllotis, Habrothrix and Oxymycterus. Mr. Thomas's arrangement shows "that the name Calomys is restricted to the small group to which it was originally applied by Waterhouse; that Oryzomys, which was hitherto supposed to include only two North and Central American species, really contains the great mass of the South American vesper-mice to which Calomys has been commonly applied; and that the range of Dr. Coues's subgenus Vesperimus extends down as far south as Peru, since it contains the two species *H. cinereus* and *H. taczanowskii*, formerly placed by me with much doubt in Rhipidomys, but which I now think must either be referred to Vesperimus or be made the type of a new subgenus" (l. c., p. 450).

Having lately, through Mr. Thomas's courteous attentions, been able to inspect these two species in the British Museum, we incline to the latter alternative, and accordingly propose the above subgeneric name, based upon the following characters: Form stout. Pelage copious. Tail about as long as head and body, hairy, but annuli distinctly visible. Soles perfectly naked. Ears hairy inside. Front upper and front lower molar each with six cusps, three on a side, opposite one another. Mammæ six. Habits monticoline. Type, *Hesperomys cinereus* Thos. Dedicated to Oldfield Thomas, Esq., assistant dept. of mammals, Br. Mus.—*Elliott Coues, Washington, D. C.*

An Egg-laying Mammal.—Without doubt the most valuable zoölogical discovery of the past year was the announcement made to the British Association, at Montreal, in a telegram from Australia, that Mr. W. H. Caldwell, who went there for the purpose of studying the development of some of the curious animals found there, had discovered that the Monotremata are oviparous, and

that the egg is meroblastic. No statement, says *Science*, was given in the telegram as to whether the observations related to the duck-bill (Ornithorhynchus), or to the spiny ant-eater (Echidna); but the main points of interest are the discovery of the oviparous habits of a mammal and the meroblastic development of its egg, as occurs in reptiles, since the eggs of mammals are, as embryologists would say, regularly protoblastic. This shows, says the reporter, that we must turn to the reptiles for the ancestors of the mammals.

THE AMERICAN BADGER IN OHIO.—Last summer there appeared in our local papers several sensational articles about a so-called "ghoul," which was robbing the graves and devouring the dead in some village or villages in Wood county.

I did not, of course, pay much attention to these wonderful stories; but some time after noticing them I saw outside a beer saloon on one of our principal streets a placard to the effect that the "Wood county ghoul or grave-robber," was to be seen within. The man inside informed me that many people had been to see the strange creature, but no one knew exactly what it was, but the best informed pronounced it a nondescript animal hitherto unknown. A single glance sufficed to show that it was a fine and unusually large specimen of the American badger, *Taxidea americana*.

The poor beast had been caught in a large steel bear-trap, and had lost one of his fore feet. He seemed quite docile and contented except when the keeper stirred him up with a stout club, when he snarled viciously, and displayed enormous strength.

I thought that perhaps the capture of a badger in Ohio, where it has long been believed to be extinct, might be a matter of some interest. His burrowing among the soft earth of the new-made graves, is in accordance with its well-known subterranean habits; and the story of its devouring the dead is in strict accordance with the mental characteristics of a rural population, though of course destitute of any foundation in fact. The rarity of the animal hereabouts is evident enough from the failure of the numerous persons, hunters and others, who saw it to identify it. —*J. H. Pooley, M.D., Toledo, Ohio, Oct. 22, 1884.*

PHASES OF KANGAROO LIFE. — The accompanying series of sketches, says the *Illustrated Sydney News*, serve to illustrate three particular phases of marsupial life, so to term them. In its wild state there is perhaps no animal more timid than the kangaroo, and in proportion to its natural timidity it possesses the acute sense of hearing. When grazing in mobs they are constantly on the alert against surprise from their greatest natural enemies, the dingo and the Australian black, whose cunning in stalking them is marvelous. What means they possess of communicating approaching danger to one another is of course a mystery, but

PLATE XXXIX.

Phases of Kangaroo Life. At Peace.

Phases of Kangaroo Life. On the Alert.

Phases of Kangaroo Life. The Stampede.

apparently the alarm usually is given by the warning animal striking the ground violently with its hind foot. The mob at once rear themselves up and sniff for the source whence danger is supposed to be approaching. The "joeys," as the young ones are called, cling to the backs of their mothers, and if very young secrete themselves in the pouches, and, led by some "old man" warrior, a stampede takes place. We are indebted to the *Scientific American* for the use of these illustrations.

HABITS OF THE GORILLA.—The gorilla recently shipped to Philadelphia and now in the possession of Professor Cope, was shot in the Ogowé delta, on the left bank of the main channel of the Ogowé river, near a place called "Orângâ" (the deep), about fifty miles in a direct line from the Atlantic ocean. Gorillas are not found on the right hand of the Ogowé, at least not near the river, but from the left bank all the way to the coast.

The great Ogowé delta, following the windings of the river, is 165 miles in length and perhaps ninety miles wide at the widest part. The upper part contains many red clay hills, one at least being 600 feet in height. Excepting these, the land is low, most of it being just below the flood line. The lowest land is covered either with coarse grass — the food of hippopotami and manati—or papavers. The higher lands and hills are covered with a dense forest or jungle of palm and other trees. The gorilla seems to be attracted to this region by two particular kinds of wild fruit of which he is very fond. He is always found in the wildest, darkest and most secluded parts of the forest, and greatly dislikes the presence of man. When aroused he is brave, and fights with great fury. He is so feared but very few men have the nerve to hunt him, especially as it is necessary to let him come within a few (twelve is the rule) feet before firing, owing to the darkness of the jungle. The man who shot this one was looked upon with wonder and admiration by all the people, every one of whom believed he was possessed of a powerful fetich or he could not have killed him. The entrails were given to some Pangwe (cannibals, the Fans of Du Chaillu and the Niam Niam of Schweinfurth) who esteemed them a great delicacy, and the universal opinion here is, that I sent him to America for the white man to eat. They were greatly disgusted with my wasting so much good rum on him when they would liked to have poured it down their throat so well. The gorilla is a rare animal even in that part of the country where he makes his home, and opportunities to obtain specimens occur but seldom. Old males, as this one, live alone, while as many as two families are seldom, at least, seen together. Many wonderful stories of them are told by the natives, but as one never knows how much to believe of native stories I will not repeat them here. In my opinion Du Chaillu is the best living authority on gorillas. I would believe his state-

ments even if they conflicted with my own observations, because he understands them better than I do . It may be interesting to note that the people here look upon them as entirely distinct from themselves, yet they call them men, "wild men" and "furrent men."

The gorilla cannot make a fire, does not build a house or shelter, and does not fight with weapons except such as nature gives him in his own body. He will seize the gun or spear of his adversary and break but will not attempt to use it in his own defence. It is about practically impossible to keep the gorilla for any length of time in captivity. He becomes dejected and morose, and either starves himself or else dies apparently of a broken heart. Traders and others occasionally get young ones—I had one myself—but they do not seem happy as do chimpanzees and other apes, and they all die in the course of a few weeks. I do not suppose an opportunity to obtain another body will occur again, if it should I will send it to you. With kindest regards I remain as ever—*Joseph H. Reading, Kângwe Mission Station, Ogowé river, West Africa.*

Zoological Notes.—*General.*—The British Museum has recently published as a separate volume a report on the zoölogical collections made in the Indo-Pacific during the voyage of H. M. S. *Alert*, 1881–'82. More than three-fourths of the volume is occupied by an account of the species found in Northeastern Australia and Torres straits. Examination of the specimens of Branchiostoma affords Dr. Günther an opportunity to revise that genus, of which he admits six species. The report describes many new Mollusca, four new asteroids, four new ophiuroids and six new holothurians. Most of the twenty-seven or twenty-eight kinds of crinoids are new, and so are forty-five of the 203 Crustacea described. Twelve species of fixed alcyonarians and forty-two out of 110 kinds of sponges are described as new. Though eighty-six of the sponge species are siliceous, none of them belong to the Hexactinellidæ. Among the new forms from the Western Indian ocean are *Turtur coppingeri* (named after Dr. Coppinger, the naturalist of the expedition). A considerable number of rare or undescribed forms of Crustacea were procured at the Amirante, Providence and Glorioso islands, and twenty one new sponges are described.

Mollusca.—As a result of a series of investigations carried on at Banyuls and at the Ecole Normale, M. Houssay comes to the conclusion that there is no homology between the operculum of the Gastropoda and the byssus of the Acephala, and none between the operculum of the former and the second valve of the latter group. The operculum is an epithelial production of a corneous or calcareous structure, while the byssus is the product of a gland situated in the anterior part of the foot. This foot-gland of the Acephala is represented in a large number of gas-

tropods by a gland in the same position, but a longitudinal furrow is added in the Acephala. Every operculum is formed of the same layers, the one produced at the posterior part of the columellar muscle, while the other is laid down upon this, thickening it upon the inferior side. Sometimes a third layer is present.

Crustacea.—The thesis which has gained for M. F. Mocquard the title of "doctor" of sciences, describes the stomach of the Podophthalmia, its motor muscles and nerves. The gastric skeleton presents a special type in each family. The brachyura have a narrow and triangular mesocardiac piece, and lengthened horizontal pterocardiac pieces, while in the macrura the mesocardiac calcification occupies the entire breadth of the upper cardiac wall, while the pterocardiac pieces are generally short and almost vertical. The gastric skeleton of the anomoura proves that some are macrura and other brachyura. While with rare exceptions the gastric skeleton of the brachyura follows the tolerably uniform type, that of the macrura presents wide variations. The schizopods and stomapods present the same calcifications as the decapods, but the lateral teeth, which are rudimentary in the Squillidæ, are well developed in the schizopods. The latter have also as their special character the absence of pyloric ampullæ, while the squillæ are peculiar in the pyramidal form of the cardiac division of the stomach. The same calcifications persist through the entire range of the Podophthalmia, that is, although they may change in form, coalesce, or occasionally disappear, no additional pieces are ever found. Guided by the characters of these parts, M. Mocquard divides the Grapsoidea into two groups, one consisting of the Ocypodidæ, the other including Gelasimus, etc., and the Pinnotheres. From his study of the muscles our author has discovered that when in use the median tooth of the stomach works into the angle made by the approach of the anterior extremities of the lateral pieces, while the uro-cardiac calcification serves to retain the aliments in the required position.

Fishes.—Mr. Gilbert has been studying the fishes of White river, Indiana, and of Kansas, and finds a few new species. Among these former is the long unrecognized *Hybopsis tuditanus* Cope, which has been placed in a new genus by Professor S. A. Forbes, on account of the separation of the small dorsal spine from the rays by a membrane as in Pimephales. It is called Hypargyrus. He also states that Hyborhynchus cannot longer be distinguished from Pimephales.——Professor D. S. Jordan has been studying the fishes of the Gulf of Mexico and of the West Indies, and has written a number of important monographs of various Percomorph genera.——Professor Gill has been adding to our knowledge of the osteology of fishes, particularly of the Anacanthini and of the Plectognathi. All the above articles appear in the proceedings of the U. S. National Museum.

PHYSIOLOGY.[1]

DOES SUGAR OCCUR IN HEALTHY URINE?—The occurrence of sugar in the urine is a characteristic sign of a well known disease, but many observers have detected in normal healthy urine a sugar like glucose in quantities varying from more than .05 per cent to less than .01 per cent. Professor Wonn Müller has attacked again the question in the following form: Does sugar normally occur in urine? Has the nature of the food influence in determining its presence? Does the excreted sugar differ chemically from that ingested? Observations were made upon two healthy students whose urine proved to be sugar free. Quantities of starch taken just before meal time had no effect upon the composition of the urine.

Levalose taken in the same way was also followed by negative results. Milk-sugar, cane-sugar and glucose, when eaten in quantities of 50 to 250 grammes, could be detected in the urine. It is worthy of observation that the sugar thus excreted was unchanged chemically and had therefore been unaffected by the ferments of the alimentary canal or by the liver cells. During this excretion the amount of fluid passed was, strange to say, rather diminished. The greater part of the sugar found was excreted in 3 to 5 hours after ingestion. Scarcely 1 per cent of the sugar eaten could be recovered in the urine.—*Pflüger's Archiv. Bd. 34, s. 576.*

WHY ALBUMEN DOES NOT OCCUR IN NORMAL URINE.—The laws regulating diffusion in the living body are among the most important and darkest problems of physiology. Albumen passes, under the forces of diffusion and filtration, through the walls of the blood-vessels into the lymph spaces; why does not albumen find its way in the same manner into the glomeruli of the kidney and form a normal constituent of urine? Graham showed, long ago, that various inorganic salts were capable of different rates of diffusion and that the individual diffusibility of each might be altered when more than one salt were mixed together; in general the diffusion of the less soluble salt was retarded. Regéczy, starting from these facts, has come to some interesting conclusions concerning the conditions regulating the diffusion of albumen. He finds that albumen in the presence of a neutral salt diffuses into distilled water less rapidly than when in watery solution, and this difference is more marked the more salt the mixture contains. Albumen diffuses more readily into salt solution than into distilled water. Diffusion of albumen proceeds more rapidly from dilute than concentrated solutions. Pressure upon the side of the albumen aids its diffusion. The explanation for these facts seems to lie in the high osmotic equivalent of the inorganic salts toward which strong diffusion currents of water are attracted, and

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Mich.

these currents accelerate or retard the diffusion of albumen as they chance to move in the same or the opposite direction to the latter. Salt and water are filtered and diffused from the blood into the glomeruli of the kidney. The water rapidly rediffuses back into the denser blood, leaving salt behind and in more concentrated solution in the kidney tubules. These return currents of water prevent the passage of albumen into the tubule, but not of the readily diffusible salts which still continue to leave the blood. The urinary secretion becomes thus progressively denser, and if by any cause the salt contents of the urine so nearly approaches that of the blood that the water currents from tubule to blood-vessel cease, then the passage of albumen begins, and albuminuria is the result.—*Pflüger's Archiv, Bd. 34, s. 431.*

Localization of Function in the Brain.—Goltz has long been the principal and worthy opponent of those who hold that the various psychical powers are distinctly and permanently localized in separate parts of the cerebral cortex. But the professor of physiology at Strassburg now concludes from the results of a new series of experiments that, though there can be no such minute distribution of function as Ferrier and others would claim, still there are manifest differences between the physiological properties of different cerebral areas. Goltz submitted a number of dogs to operation, removing in some cases the cortical anterior and in others the posterior portions of both hemispheres. The animals were kept under observation for some months after complete recovery. The behavior of the dogs differed according as the anterior or posterior part of the brain was affected. 1. The dog from which the anterior part of the cortex had been removed retained all the bodily sensations; he may possess a fine tactile sense but still he uses that sense ill. He treads the air with the feet when walking. No muscles are paralyzed, all are under voluntary control, still the movements are clumsy and, rather helpless. The attempts at feeding are particularly unskillful; he does not understand how to hold a bone with the fore feet. He does not hesitate to leap down from an elevation. Reflex irritability is increased. Very frequently the animal's character becomes changed so that he is more impatient and more easily angered than before the operation. He wanders restlessly about. Sense perceptions are not weakened in a very marked manner, but general intelligence is always somewhat lowered. 2. The dog which has lost the posterior portion of the cerebral cortex retains undisturbed his tactile sensations and appears to use them well. He does not beat the air with the feet when walking. His muscles are not only not paralyzed but he uses them nearly as skillfully as a normal dog. He hesitates to jump down from an elevation. Reflex irritability is not heightened. If the animal were savage before the operation he becomes quite docile after it; he cannot be stirred up to any emotion. He suffers a general weakness of

perception and his general intelligence is very low. A dog which has suffered the loss of the anterior cortex has usually a tendency to emaciation, while one whose brain has been operated on posteriorly is always fat; the former animal is also liable to a severe skin disease accompanied by itching.—*Pflüger's Archiv, Bd. 34, s. 450.*

PSYCHOLOGY.

THE PSYCHICAL RELATION OF MAN TO ANIMALS.[1]—Professor LeConte's article opens as follows: "In the *Review* for November, 1878, I published an article on 'Man's place in nature.' The present article may be regarded as a continuation of the subject from a different point of view. In the former article I tried to show how, without violating the laws and analogies of nature, the spirit of man may be conceived to have arisen by progessive individuation out of the forces of nature, through the vital principle of plants and the anima of animals. In this I wish to fix attention on the last and most important step, and to determine, if possible, its nature. I wish to show in what consist the essential differences between the spirit of man and the anima of animals."

Professor LeConte admits the probable evolution of the human mind out of the animal mind, but believes that at some point of history, one perhaps coincident with the origin of the human species, a new type of mental power originated, which constitutes the spirit of man. He illustrates this proposition by reference to the history of development of human individuals at the present day. He traces the appearance of this especial power in the growth of the mind of the child, in language, in useful art, in fine art, in thought proper, in self-consciousness, and in free will. The power in question is simply the power of generalization. It commences in thought, in which it is the perception of law; it appears in speech in the power of expression of such perception of law; in useful art in the conscious working for a purpose; in fine art in the perception and execution of harmonies. These propositions are clearly presented and ably argued. They express a great truth, one which is probably true of all normal human beings. It is, however, not so certain that the power of generalization is limited to man. It is probably not so limited, but exists in a small degree in the mental operations in the highest animals. Hence we cannot perceive that Professor Le Conte proves in this way the existenee of a "human spirit," distinct from "the anima of animals." Professor Le Conte does not, it appears to us, grant sufficient mentality to animals, especially in his discussion of imagination (p. 252). His belief, however, that the memory of animals is not, in their minds, distinguished from present events, is probably partly true, though we can scarcely believe that the highest animals do not retain an idea of the true successional relation of events.

[1] By Professor Jos. LeConte, rom the *Princeton Review* (no date on the separata).

Self-consciousness is regarded by Le Conte as peculiar to man. This may be, but we have not yet looked into the recesses of the minds of the lowest races of man, nor do we know the conditions of the minds of the chimpanzee and orangutan in this respect.

The author believes in free-will as that form of mental activity "in which consequences, especially moral consequences, are presented to the mind and weighed; when impulses, solicitations, motives, are weighed one against another; when all these mental conditions become themselves in their turn the objects of conscious thought, and we feel distinctly conscious that we ourselves determine, and are therefore responsible for, the final result," etc. This form of stating the case will naturally be regarded by the determinists as a *petitio principii*. If the author of it had wished to strengthen his position as fully as it is susceptible of support, he should not have omitted the argument to be derived from the condition of ignorance coïncident with high intelligence, where the experience which is the condition of automatism is wanting, and when, therefore, if progress is made, acts must be free if they are ever so. Though this hypothesis[1] is not a demonstration, it is as near to it as we shall ever get, and preferable to mere assertions of our belief in our freedom. In one paragraph, under the head of free-will, Professor Le Conte allows his theology to get ahead of his philosophy (p. 259). He says "there is a free-will, which is free only in the sense of self-determined, and therefore morally responsible, but is nevertheless unwillingly restrained by and chafes against the impassable bounds set about it by the all-embracing will of God, which is the perfect law of Righteouness —and there is a freer will, freer because no longer restrained by law; because the law of righteousness is freely accepted as the law of its activity; because it moves in loving accord with the absolute will." Now to say nothing of the assumption contained in this paragraph as to the origin and nature of the law of righteousness, the assumption of superior freedom of will on the part of him who obeys this law, is illogical. That man in whom the law of righteousness is habitually obeyed is, so far as this fact is in evidence, as much of an automaton as he who obeys only the laws of his animal instincts. The period of creation, which is a period of labor, is preëminently the period of freedom, and good habits are clearly just as automatic as bad ones. *It is however not necessary to believe that a freedom of will once gained need ever be lost.*

Finally, this supposed freedom of will cannot be attributed to animals. But it is far from certain that it is possessed by all men, that its assumption as a distinctively human characteristic is not exact. It may be rather a *possibility* for men, and as such more

[1] On the origin of the Will, by E. D. Cope. *Penn Monthly*, 1877, p. 435.

likely to prove the "spirit" or "soul" of man, so much talked of, and so little explained, than any other mental quality.—*E. D. C.*

MORE CONCERNING CATS' FOOD.—It was said by some eminent man that no one could know any one subject perfectly without knowing a little of everything. I base my claim to this universal knowledge on cats.

On our old place in the country we maintained a small standing army of cats, to keep down the rats, which had overrun the house and farm-buildings, and had defied fire-arms, poison and traps. These cats were not pets; they lived very greatly in the woods and fields and were just enough domesticated to give a fair chance of observing their ways. It was soon perceived that there was almost as much diversity of taste among them, in regard to food, as there is among human beings. They all ate meat and milk, and there, I think, the community of taste ended.

There were many generations before my own recollection serves me very clearly. The first one that stands out very clearly in my memory is "Old Trilobite" so-called, somewhat viciously, not from her extreme antiquity, but on account of a peculiar *trill* in her voice. Old Trilobite was a small, slender Maltese. She lived little in the house, save in the coldest part of the winter; she was a mighty hunter, and the mother of a numerous and hardy progeny of almost every possible variety.

She would not touch butter, nor anything made with it, although it was the best of fresh butter, nor would she eat anything sweet. She was partial to sour milk. She was often absent for days on hunting excursions in the woods; on her return she refused every kind of butcher's meat, but it was accidentally discovered that she would eat *raw salt pork* on such occasions; she also demanded bread, and would eat a quantity of it. I do not remember any other cat that ate salt pork, or indeed any salt meat or fish (unless it had been very much "freshed," which amounts to the same thing), and old Trilobite seemed only to eat it as a corrective to an exclusive game diet.

"Jack," one of Trilobite's kittens, resembled her in many respects as to habits, but did not accord with her dietary. She ate cake. She was also very partial to cheese, which Trilobite would not touch. Cats differ greatly as to their liking for cheese. Some are extravagantly fond of it; others will not touch it.

Cats, in general, like green vegetables. Asparagus is a favorite. Corn, beans and peas many cats will eat raw. Corn, Dr. Dimmock mentions, is often eaten by cats who do not care for other vegetables. Potatoes, generally, are refused. As an odd taste, I remember that of one who would eat the *peels* of boiled potatoes, but not the potatoes themselves; in this case it was the mere skin stripped carefully off, with little or no potato adhering to it

Pet cats, Dr. Dimmock has remarked, will usually eat anything

the petter eats, or at least try to do so. I have seen them eat candy, dates and figs. One, only a semi-pet, who usually rejected sweets, was found one day picking out and eating the raisins from a piece of cold pudding.

Some cats will positively eat nothing but meat. I had one such. He was a yellow and black brindle, and I understood that this was a hereditary trait. But he once made an unexpected raid on some cream-cakes, and once condescended to eat Brighton biscuit. My present cat, "Pug," has much of the same tastes. He will now and then, out of politeness, take a bit of something else, but will not really eat anything but meat. He does not, however, like it raw, except when very hungry, a few bits of raw beef, other meats not at all. I have known of cats who would eat *only* raw meat, but never had such a one.

Almost all cats will eat eggs—cooked or raw. "Pug" would, in his younger days, but he is apt to refuse them now. "Nanny Longclaws" (originally "Ninon de l'Enclos") was so fond of eggs that breaking the shells would bring her rushing into the house even from such a distance that one would have thought she could not hear the sound.

They are, I think, to a cat, fond of fish—many extravagantly so. Oysters are in the same standing as cheese among them. Some will cry bitterly for them as soon as they perceive they are on hand; others reject them positively.

"Blanche," one of the two cats now attached to the establishment, will, I believe, eat *everything* except fruit and salt pork. She was born omnivorous, not having been especially petted in her kittenhood, nor brought up on a miscellaneous diet.

One Maltese cat, attracted probably by the musky odor, would not only drink the water in which India ink had been mixed by washing the brushes, but lick the saucer on which the ink had been rubbed. They are partial to perfumes.

A great many of them, as Dr. Dimmock observes, will catch and eat insects. "Blanche" has a great liking for dor-bugs. Moths are favorites too. "Squash-bugs," I judge, are not, remembering the highly disgusted expression and attitude one assumed after an attempt to deal with one of those highly-flavored creatures. Devil's darning needles I have seen caught and devoured. Grasshoppers, I think, are usually acceptable. I, too, had a cat who used to catch and bring them to me. Another one caught frogs and brought them to me, and, I fancied, was rather disappointed that I did not eat them. They will kill snakes, and sometimes partially eat them.

Much that is interesting can be said about the long-neglected and greatly-calumniated cat. I think its psychology deserves attention. I have observed in them a capacity for friendship among themselves.—*Francis M. Slack, Librarian Mus. Comp. Zoology.*

ANTHROPOLOGY.[1]

ASSOCIATION NOTES.—The meetings of the British and the American Association in coöperation brought together many anthropologists of distinction, and the papers read were of uncommon interest.

At the British Association the important feature was the address of vice-president Tylor on some American aspects of anthropology. A few of the topics discussed in the paper were:

The effect of a quarter of a century's research the giving to Quaternary man a more and more real position.

Did man likewise inhabit America at the same period?

Are the present Eskimo the remnant of such an early race?

(Upon this last point Mr. Tylor suggested a yachting cruise down the coast of Labrador to fix the locality of Vine-land.)

The recent advances of zoölogy and geology have given new breadth and facility to the discussion of the relation of the North American aborigines to Asiatic peoples.

The only safe method of philologic research is the combination of dictionary and grammar. Attempts to trace analogies of words in Asiatic and American languages have proved no correspondence beyond what chance coincidence would produce.

The comparison of peoples according to their social framework has not assumed a great importance.

The tendency to treat everything prehistoric as necessarily o great antiquity is growing weaker.

The northward drift of ancient American civilization is evidenced by the distribution of maize, tobacco and cocoa, and the spread of agriculture.

Mr. Horatio Hale read a treatise on "The origin and nature of wampum." It was a notable fact, he said, that while the partly civilized Indians of Central and South America carried on commerce without money, among those of the United States and Canada a monetary currency was in common use. Their wampum was formed in the shape of small disks or cylinders, of shells perforated through the center and strung together on strings of deer's sinew. The system had been found so convenient for purposes of exchange that it had even been adopted by some of the early colonists. In most cases the material was the conch periwinkle and *Venus mercenaria*. The colors were white and purple, or black—which was twice as valuable as the white, on account of its rarity. These shell arrangements differed from the cowries of the East Indies. In course of time they came to have a social and political significance. Important acts of state policy were confirmed by the gift or exchange of them. On the occasion of treaties belts of wampum were presented. Each belt had its own device woven in white on a dark

[1] Edited by Professor OTIS T. MASON, National Museum, Washington, D. C.

ground, or *vice versa*. The rude pictorial emblems generally employed resembled the early Chinese characters. Wampum was also devoted to sacrificial and funeral ceremonies. It has been found in abundance in the mounds of the Mississippi valley; and, in our own times, was in vogue west of the Rocky mountains. In traffic, the value was rated sometimes by the length of the strings, sometimes by the number of beads. There was a larger kind, consisting of oblong strips, with holes for stringing. Going far to the westward there was found among the Micronesian islanders an almost similar usage. They made their wampum of the disks of shells, of cocoa-nuts or of the tortoise-shell. In the Loo-Choo islands the inhabitants had what was known as "cash," small circular copper coins. The Chinese themselves anciently used tortoise-shells. Of the earliest Chinese copper money, some pieces were round, others oblong. The Celestials had also mock-money, made of tin foil and paper for sacrificial uses, which might be taken as evidence that their money at first consisted of combustible material. The inference to be drawn from the existence of such media of commercial exchange among those oriental peoples was, that at some period the idea of shell money had been carried from East Asia or Micronesia to the shores of America. The fact that Japanese junks had been known to be wrecked on the Pacific coast was to the point in the argument. The Micronesians, moreover, were accustomed to make protracted voyages in their well-rigged vessels, and it was not impossible that some of their craft might have drifted to our shores where the occupants would come in contact with the Indians. Whether, however, the use of wampum was derived from the East or not, it could not be denied that it gave evidence of good intellectual powers. It was to be regretted that a subject of such interest had been so long treated with indifference in America. At present there was great scarcity of wampum belts, though some that had been preserved were of deep interest and of considerable historical value. One which was shown to the audience was said to be 160 years old. It was of rare beauty of make and significant design. Four dark squares (the rest being of white beads) were interpreted to mean four Indian towns. Another which Mr. Hale exhibited was even more remarkable in its structure, displaying emblematic figures. The use of wampum for mnemonic purposes was also explained, and Mr. Hale showed photographs of the chiefs (Six Nations) to whom he was indebted for his interpretation. Interesting to Canadians were some beads found in Orillia county by Mr. Hirschfelder, who believed they had been the property of the Hurons.

The paper gave rise to a most animated discussion, in which Mr. Cushing (who had spent so many years among the Zuñi Indians), Mrs. Erminnie Smith, Mr. Putnam, Major Powell and Dr. Tylor took part. All the speakers expressed the deep satisfac-

tion with which they had listened to the paper, and their gratitude to Mr. Hale for the light that he had shed on a subject so important.

The address of Professor E. S. Morse, as vice-president of Section H of the American Association, was upon Man in the Tertiaries, the full text of which was given in the October NATURALIST.

The following papers were read at the meeting:

Uses of the emblematic mounds. Stephen D. Peet.

The lineal measures of the semi-civilized nations. D. G. Brinton.

Description of the skeletons and skulls found in the large mound of the Turner group. Miss C. A. Studley.

The sacred pipes of friendship. Frank LaFleche.

Some observations upon the usage, symbolism and influence of the sacred pipes of fellowship among the Omahas. Alice C. Fletcher.

Notes upon some quartz objects from Central Minnesota. Miss F. E. Babbitt.

The importance of the study of primitive architecture to an understanding of the pre-historic age in America. Stephen D. Peet.

Local weather lore. Amos W. Butler.

Some characteristics of the Indian earth and shell mounds on the Atlantic coast of Florida. Andrew E. Douglass.

The manner in which Indians made their stone implements. P. R. Hoy.

Disputed points concerning Iroquois pronouns. Erminnie A. Smith.

The use of the plough in Japan. Edward S. Morse.

The sacrificial stone of San Juan Teotihuacan. A. W. Butler.

Mythology of the Wintuns. J. W. Powell.

Archæological explorations by the Peabody Museum of American Archæology and Ethnology, communicated at the request of the trustees of the museum. F. W. Putnam.

Interviews with a Korean. Edward S. Morse.

Some parallelism in the evolution of races in the old and new world. Daniel Wilson.

On the geographical distribution of labretifery. W. H. Dall.

Remarks on North American races and civilization. E. B. Tylor.

Upon the evolution of a race of deaf-mutes in America. A. Graham Bell.

The occurrence of man in the Upper Miocene of Nebraska. Edward D. Cope.

The three culture periods. J. W. Powell.

A search in British North America for the lost colonies of Northmen and Portuguese. D. G Haliburton.

Eastern archery. Edward S. Morse.

Formation of Iroquois words. Erminnie A. Smith.

The different races who built mounds in Wisconsin. Stephen D. Peet.

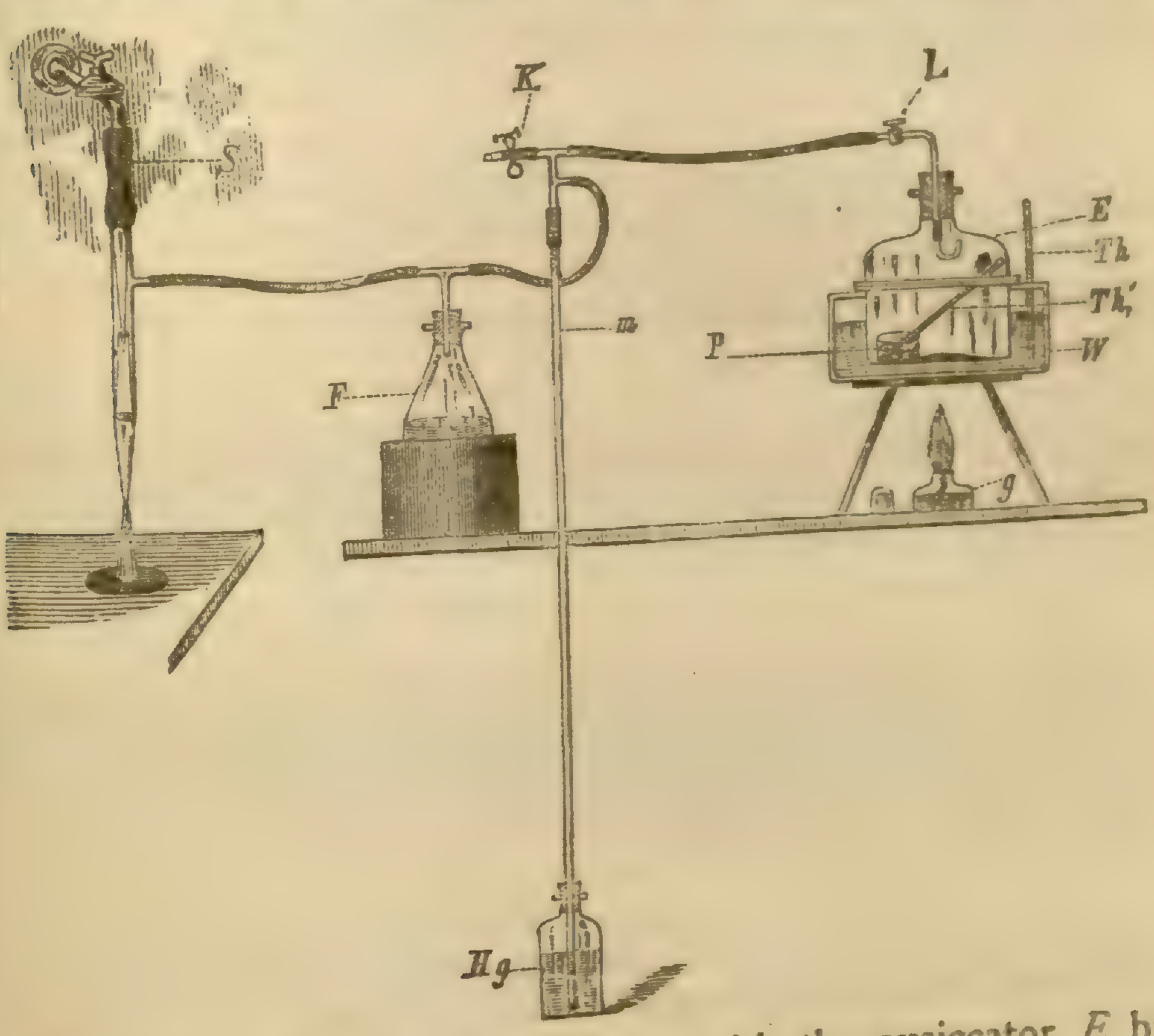
Evolution of animal life illustrated by study of emblematic mounds. Stephen D. Peet.

Etymology of the Iroquois word Rha-wen-ni-yu. Erminnie A. Smith.

A CORRECTION.—In noticing the brochure on the Okadaira shell mound, at Hitachi, the editor of these notes, in praising the Japanese explorers, inadvertently did injustice to Professor Morse. It is well known to all of the readers of the NATURALIST that the entire credit of the exploration in the Omori shell-mound, and of the publication of the results, is due to Professor Morse, and no one would be more willing to acknowledge that fact than the present writer.

MICROSCOPY AND HISTOLOGY.[1]

IMBEDDING APPARATUS.—The complete saturation of objects more than a few millimeters in thickness with paraffine is often a difficult operation. After soaking for hours in melted paraffine, it is frequently found, when it is too late for remedy, that saturation has not been sufficiently complete in all parts of the object. In imbedding relatively large anatomical preparations, the penetration of the paraffine to all parts can be secured by the aid of a good air-pump; but this method is tedious, and robs one of time. The same end may be reached with very little cost of time and labor by means of a suction-pump, such as is used in chemical laboratories, provided only that the water pressure at command is sufficiently great to do the work. Dr. F. W. Hoffman[2] has described a very simple apparatus to be used with the suction-pump.



The suction-pump, *S*, is connected with the exsiccator, *E*, by means of rubber tubing, through each portion of which runs a piece of glass tubing as a protection against undue compression. The exsiccator, holding the small basin of paraffine, *P*, in which is placed the thermometer, *Th'*, stands in a zinc pan, *W*, containing water and a thermometer, *Th*. The capacity of the pan should be such that the temperature of the water can be kept quite even during the process of imbedding. The-flask, *F*, introduced between

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] *Zool. Anz.*, VII, No. 165, p. 230, 1884.

S and *E* by means of a T-shaped tube, serves to catch any water which may find its way into the connecting-tube in consequence of variation in the water-pressure. The glass tube, *m*, the lower end of which is in a bottle of mercury, serves as a manometer. The pressure indicated enables one to judge whether the preparation is saturated with paraffine.

In using this apparatus the water-bath, *W*, should be first heated to a temperature of about 60°; then the basin, *P*, containing *melted* paraffine and the object to be imbedded, may be placed in the exsiccator and the pump set in operation. When the mercury reaches the highest point in the tube, *m*, and air-bubbles cease to rise from the object, the process is ended, and the air admitted by loosening the screw-clamp, *K*. Before admitting the air, the stop-cock, *L*, can be closed, in case it is thought best to leave the preparation still longer in vacuum. As soon as sufficient time has been given for complete saturation, the stop-cock, *L*, is opened slowly, and the air streams in. The end of the connecting-tube is bent upward in *E*, in order that the paraffine may not be disturbed by the inflowing air. Finally, the object is taken out and placed in a box of melted paraffine and left to cool.

With a water-pressure of 700—720 mm. Hg., most objects will be completely saturated within 20 minutes.

TREATMENT OF THE OVA AND EMBRYOS OF THE APHIDES.—Witlaczil[1] gives a lengthy paper on the development of the aphides, and in it the following information on methods:

The embryos of the viviparous aphides were examined in a weak salt solution (1 ½ per cent), in which they live for about an hour. The ovaries contain embryos in different stages of development, and have to be isolated for study.

The early stages in the development of the ova may be studied to advantage after treatment with hydrochloric acid (3 per cent), or acetic acid, as these reagents partially dissolve the yolk elements and thus render the preparation more transparent. The later stages, on the contrary, are rendered more opaque by the same treatment.

The ovaries of viviparous aphides were prepared for sectioning, by Ludwig Will,[2] in the following manner:

The aphis is killed in water heated to about 70° C., then hardened in successively higher grades of alcohol. In order to color in toto, the cuticula must be punctured with a sharp needle, and then the dye will penetrate easily to all parts. As very thin sections are required for the study of such small elements, it is best to use dyes that stain very deeply, such as borax-carmine and hæmatoxylin. It is further necessary to employ either the shellac or the collodion method of fixing the sections, otherwise the important parts are liable to drop out of place.

[1] *Zeitschr. f. wiss. Zool.*, XL, Heft 4, p. 563–564.

[2] Semper's Arbeiten, VI, 1883.

THE ORGANIZATION OF THE ECHINORHYNCHI.[1]— 1. *Method of Preparation.*—It is a very difficult matter to kill Echinorhynchi instantly. This cannot be done either with corrosive sublimate or strong osmic acid, even after preliminary treatment with tobacco smoke or chloroform. Thus treated, they contract strongly, and remain so after death.

Much the best results are obtained by killing gradually with 0.1 per cent osmic acid, in which they contract during the first hours, but stretch out again and die fully extended. This method causes slight swelling, but does not seriously injure the object for histological investigation. In specimens left for twenty-four hours in the osmic acid, it is easy to isolate under the dissecting microscope the subcuticula, and the two layers of muscle-fibers (circular and longitudinal). For the study of the internal organs, the Echinorhynchi should be cut open immediately after death and transferred to a 0.01 per cent solution of osmic acid. The preservation of specimens thus treated may be accomplished in the following manner: After carefully washing away the osmic acid, place the objects in a very dilute solution of potassic acetate in an open vessel, and leave them for two or three days, during which much of the solution evaporates. Finally transfer to a saturated solution in order to clarify so far as possible. Very beautiful preparations are said to be thus obtained.

The course of the nerves may be easily traced in specimens that have lain several days in 1 per cent formic acid. The tissues swell up strongly and become quite transparent so that the nerves can be seen. If the muscular layers be separated from the subcuticula in specimens thus treated, and then stained in gold chloride, the lateral nerve-trunks may be clearly shown. For the histological study of the nerves, the Echinorhynchi should be treated with chromic acid and then stained deeply with borax-carmine.

Chromic acid preparations are also best for the study of the subcuticula. Echinorhynchi live for days in a one-tenth per cent solution of chromic acid, but eventually die in a fully extended condition. Such preparations, after treatment with alcohol, may be colored at once; or, after washing a day or more in running water, exposed to the action of osmic acid, and then colored in borax-carmine.

For the study of the sexual organs, a very dilute picro-sulphuric acid (one part of the acid to eight-tenths part of water) is recommended.

The tissues of the Echinorhynchi are not easily stained. Borax-carmine, which, according to Sæfftigen, is the best staining fluid, must be allowed to act a long time (often one or more days); after a deep stain has been taken, the preparation should be partially discolored by the use of hydrochloric acid in the ordinary way.

[1] *A. Sæfftigen, Morph. Jahrb.*, x, Heft 1, pp. 120–163, 1884.

2. *Histology.*—The outer body-wall of the Echinorhynchi consists of four layers: a very thin *cuticula*, a thick *subcuticula*, an *outer muscular layer* (circular fibers), and an *inner muscular layer* (longitudinal fibers).

The subcuticula, which constitutes by far the larger portion of the body-wall, is a complicated web of muscular fibers, in which may be distinguished an inner and an outer zone. The inner zone, lying next to the layer of circular muscle-fibrils, is made up of radial fibers united into bundles. These bundles have the shape of sheaves, the fibers spreading at the ends, but drawn closer together at the middle, so as to leave a system of spaces or canals. Two longitudinal canals are thus formed, having in some species a lateral position, in others a dorsoventral position; and these main trunks are connected by a net-work of anastomosing canals. This system of vessels is filled with a clear fluid, in which numerous granules, resembling oil spherules, together with large nuclei, are suspended. The wall of these vascular spaces consists of radial muscle-fibers alone, showing no indication of a lining epithelium. Sæfftigen thinks that the canal-system of the anterior end, including the lemnisci, does not communicate with that of the rest of the body.

The outer zone of the subcuticula is made up of alternating strata of longitudinal and circular fibers, and is not penetrated by the canal-system. The radial fibers of the inner zone penetrate this outer zone, and reach to the cuticula. Between this outer zone and the cuticula is found a layer which Baltzer has called the "*Streifencuticula*," and which has hitherto been regarded as an inner cuticula. Sæfftigen has brought forward pretty conclusive evidence that this layer is not cuticular, but muscular; and he holds that it is merely a bounding zone of the subcuticula, in which the muscular fibers are more closely packed than in the so-called "outer zone" of the subcuticula. The subcuticula presents essentially the same features in the proboscis and neck as in the body proper.

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SCIENTIFIC NEWS.

— The meeting of the British Association at Montreal was an extremely interesting one and very largely attended; while the interest was mainly centered upon topics pertaining to physics, the proceedings of the sections of geology and of biology were notable. The section of geology was presided over by Dr. Blanford; fifty-one papers were presented. Aug. 29th was given to essays and debates on glacial phenomena, in the course of which Professor James Geikie expressed his inability to draw any sharp line between moraines and kames, as they merge into each other so that one cannot say where one leaves off and the other begins. Kames he regarded as partly morainic and partly of subglacial origin. Debates on the archæan rocks, and the eozoön, were

opened by Professor Bonney. The most fresh and interesting palæontological essay was that of Mr. G. F. Matthews on the primitive Conocoryphean.

The section of biology was presided over by Professor Moseley, of Oxford, whose opening address was on the physiology of deep-sea life. A paper by Mr. C. Spence Bate, of Plymouth, England, on the geographical distribution of the macrurous Crustacea, led to a discussion in which Professor Moseley remarked that deep-sea Crustacea either had very large eyes or were eyeless, and that there must be a source of light in the deep sea, that source, he claimed, was phosphorescence, but its light must be very dim.

An abstract of Dr. Sollas' paper on the origin of fresh-water faunas has already appeared in this journal. Papers by G. E. Dobson on the geographical distribution of the bats, and by H. Saunders on that of the gulls and terns (Laridæ) was followed by an essay by Professor Gray on the distribution of plants, wherein he called attention to the resemblances and differences between the flora of North America and that of Europe.

A telegram was received from Mr. W. H. Caldwell announcing his discovery that the Monotremata (whether the Ornithorhynchus or Echidna was not stated) are oviparous, while its development is meroblastic as in reptiles. This is certainly the most remarkable zoölogical discovery of the year.

Professor A. Milnes Marshall read a paper on the mutual relations of the recent groups of Echinoderms, with especial reference to their nervous systems; his results we shall present hereafter. Other communications we shall notice in a later number.

— The Chesapeake Zoölogical Laboratory of the Johns Hopkins University was opened for research, at Beaufort, North Carolina, from June 1st to September 19th, and its facilities were used by ten naturalists. Owing to the illness of the director, Professor W. K. Brooks, he was able to spend only one month at the laboratory, and it was, for two months, in charge of H. W. Conn, Ph. D., professor of zoölogy at the Wesleyan University, Middletown, Conn. The experiment, of a year since, in Chesapeake bay, has demonstrated that Beaufort is the best available locality for work. The building at Beaufort furnishes accommodations for only six persons, and as the party of ten crowded it so much as to hamper the work the director was compelled to refuse several applicants.

— M. Bertrand, the Secretary of the French Academy of Science, recently made the important announcement that England had joined the International Commission, which meets once a year at Paris, to consider the metric system. Thus England sets itself in accord with the ideas of all Europe, and in the near future will make the French system obligatory. This decision, taken by England at the last moment, that is to say at the opening of the

International Congress at Washington which is to determine a common prime meridian, is not, perhaps, an absolutely disinterested one. England desires the ratification of the decision of the Scientific Congress held last year at Rome, which adopted the meridian of Greenwich.—*Exch.*

— A useful pamphlet is Mr. John A. Ryder's tract "On the preservation of embryonic materials and small organisms, together with hints upon imbedding and mounting sections serially. Extracted from the annual report of the Commissioner of Fish and Fisheries for 1882." The principal object of this essay, says the author, is to afford directions to collectors desiring to preserve the embryos of the lower vertebrates, fishes and amphibians in such a condition as will enable the investigator to use them in his researches. "As ordinarily preserved in alcohol such objects are next to worthless, either for figuring or dissection, as well as totally useless for microscopic preparations."

— The U. S. Geological Survey is engaged in a bibliography of North American geology. The work when completed will give the title of each paper with the title-page of the containing book, and the number of plates, the whole being arranged alphabetically by authors. It is also intended to prepare at the same time a number of more restricted bibliographies, each covering a division of geological literature. The plan includes abbreviated titles of papers with references to the pages on which the special subjects are treated, the entries in each bibliography being arranged alphabetically by authors.

— The editor of *Papilio* announces "that unless a more self-sacrificing and less impecunious and business-like editor can be found, *Papilio* will probably cease to exist at the end of this year." We hope that relief will be sent to the editor and publisher, Mr. Eugene M. Aaron, lock box 916, Philadelphia, Pa., and would add *apropos* of entomological journals in this country, that if the three now published could be consolidated into one, it would be better in all respects. We still need a well sustained entomological journal, such as ornithologists possess in the *Auk*.

— At the meeting of the Entomological Club of the American Association Adv. Science, at Philadelphia, Dr. Horn called attention to the historical associations connected with the place in which the club then met. "On that very spot, in the old Museum of Natural History, Thomas Say, poor in pocket, though rich in brain, put up his bed under the skeleton of some large mammal, and this for months was his only home. There also he contracted the illness which resulted in his death."

— The Museum of Comparative Zoölogy has published the third in its series of bibliographies to accompany "Selections from embryological monographs, compiled by Alexander Agassiz, Walter Faxon and E. L. Mark." This part is a bibliography of Acalephs, by J. Walter Fewkes, and bears date of July, 1884.

This series, with its admirable illustrations, are most useful adjuncts both for the beginner in zoölogy as well as the working embryologist.

—During the quarter ending September 1st, 13,796 persons have visited the museum of the Peabody Academy of Science, the largest number on any one day being 456 July 1st, the day Barnum's circus was in Salem. The most important accession to the museum has been a collection of lemur skins from Madagascar.

—C. H. Gilbert has been appointed Professor of Biology in the University of Cincinnati in the place of Professor W. G. Wetherby resigned. Joseph Swain takes the place of Professor Gilbert as assistant professor in the University of Indiana.

—George Bentham, the distinguished English botanist, died Sept. 10 at the age of 84. His Hand-book of the British Flora was widely used in Great Britain, while Hooker and Bentham's Genera Plantarum, finished a year ago, made his name familiar to botanists the world over. His work in systematic botany has extended over half a century, beginning in 1825.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of Natural Sciences Philadelphia, March 27, 1884.—Professor Lewis reported the discovery of itacolumite at two localities in Pennsylvania, one in Lancaster county, the other near Spring Mills, on the Schuylkill. He believed the itacolumite to be identical with the Potsdam sandstone. Mr. Hotchkiss gave details respecting the coal mine at Pocahontas, where 114 miners were recently killed by an explosion, and suggested that the dry coal dust in the air of the mine, by mingling with the gases of the gradually rising galleries, may have been the cause of the catastrophe.

April 3.—Dr. Leidy called attention to the existence of a reef of *Serpula dianthus* at Barnegat bay. Mr. Ford reported the finding of several specimens of *Mellita testudinaria* on Anglesea beach, N. J.

April 10.—Dr. D. G. Brinton was inaugurated as professor of ethnology and archæology, and delivered a lecture on prehistoric man in America. After giving due weight to all objections, the lecturer argued that there was evidence in favor of the presence of man upon this continent long anterior to any historic date of the old world. The origin, development and history of the native American race must, therefore, be studied separately, without any attempt to identify it with any race of the eastern hemisphere. The common origin must be placed very far back.

April 17.—Dr. C. Dolley suggested with regard to the so-called parenchymatous digestion of Salpa and Auchenia, an interpretation totally different from the one usually received. The

endostyle of the branchial sac, in Salpa, throws out a supply of mucus which covers the surface, and in which nutritive particles, finding their way into the animal, are imbedded. The food is carried back by cilia, and the mucous sheet is wound up into a thread which can be traced into the œsophagus, and thence into the stomach. This mucous exudation Dr. Dolley believes to be identical with the amœboid cell which has been described as taking up the nutritive particles and passing them on to the tissues. Dr. N. A. Randolph described a test for the detection of small quantities of peptones in solution.

April 24.—Dr. Leidy called attention to a discovery of fossil remains of mammals in Florida, indicating the existence of a formation of later Miocene or Pliocene age differing from those before known. Though mostly in fragments, the fossils exhibit no appearance of being water worn or abraded by friction. Among the remains were those of a mastodon, also of a rhinoceros rather shorter than the existing species, bones of a llama, a tapir and of a large ruminating animal exceeding in bulk the Irish elk. Professor Heilprin stated that rock fragments received from Mr. Willcox contained six or seven genera, and specimens of microscopic Paludina were associated with them. These might indicate the presence of fresh-water swamps in ancient Florida, or the emptying of a river into the sea.

NATIONAL ACADEMY OF SCIENCES, Newport, R. I., Oct. 14, 15, and 16, 1884.—The following papers were read:

On the columella auris of the Pelycosauria. By E. D. Cope.
The brain of Asellus and the eyeless form of Cecidotæa. By A. S. Packard.
On the theory of atomic volumes. By Wolcott Gibbs.
On the complex inorganic acids. By Wolcott Gibbs.
Notice of Muybridge's Experiments on the motions of animals by instantaneous photography. **By Fairman Rogers.**
Notice of Grant's difference engine. By Fairman Rogers.
On the Thinolite of Lake Lahontan. By E. S. Dana.
On the Mesozoic coals of the Northwest. By R. Pumpelly.
On the work of the northern transcontinental survey. By R. Pumpelly.
The grasses mechanically injurious to live stock. By Wm. H. Brewer.
On gravitation survey. By C. S. Peirce.
On minimum differences of sensibility. By C. S. Peirce and J. Jastrow.
Researches on Ptolemy's Star-Catalogue. By C. H. F. Peters.
On the operations of the United States geological survey. By J. W. Powell.
The motion of Hyperion. By Asaph Hall.
Remarks on the civilization of the native peoples of America (by request). By E. B. Tylor.
Some results of the exploration of the deep sea beneath the Gulf Stream, by the U. S. Fish Commission steamer *Albatross* during the past summer. By A. E. Verrill.
Recent progress in explosives. By H. L. Abbot.
On an experimental composite photograph of the Members of the Academy. By R. Pumpelly.
Report on meridian work at Karlsruhe. By W. Valentiner.
On the algebra of logic. By C. S. Peirce.
On the temperature of the lunar surface. By Samuel P. Langley.
On methods of eastern archery. By Edward S. Morse.

APPALACHIAN MOUNTAIN CLUB.—Oct. 8, 1884.—A paper by Professor George Davidson entitled "Account of the Volcano

Makushin, on the Island of Unalaska, in the Aleutian Chain," was presented by Professor E. C. Pickering. Dr. J. F. Frisbie read a paper entitled "A tramp over Ossipee mountain."

Professor Samuel H. Scudder presented a communication on "The movement of Hôtel des Neuchatelois on the Glacier of the Aar."

NEWTON NATURAL HISTORY SOCIETY.—At the annual meeting in October the following officers were elected: president, Dr. J. F. Frisbie; vice-president, George L. Chandler; treasurer, S. E. Warren; secretary, A. C. Brackett; curator and custodian, Jesse Fewkes. A resolution was passed in commemoration of the late John L. Ordway, who was an active member of the society. The annual address was delivered by the president, J. F. Frisbie, his subject being "A tramp through Tuckerman ravine up to the summit of Mt. Washington."

NEW YORK ACADEMY OF SCIENCES.—Oct. 13th.—The following paper was read: Notes on a recent visit to Northern Montana, —its scenery, resources, and geological structure (with lantern illustrations), by Dr. John S. Newberry.

Oct. 20.—The following papers were read: Notes on the constitution of oceanic, river, and desert sands, by Dr. A. A. Julien; On certain peculiarities of the mussel (Mytilus), by Mr. B. B. Chamberlin.

Oct. 27.—Notes upon the recently-discovered columnar trap exposures on the east face of Orange mountain, N. J., were presented by Professor D. S. Martin, Professor H. L. Fairchild, and Dr. N. L. Britton, with photographs and sketches taken by Professor Fairchild and Mr. B. B. Chamberlin.

BOSTON SOCIETY OF NATURAL HISTORY.—Oct. 1, 1884.—Mr. S. Garman spoke on sharks and their classification.

Oct. 15.—Professor Hyatt spoke of the discovery of supposed winter buds in a marine sponge.

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY.—April 18.—Extracts from a report on the Ham's Fork coals of Wyoming Territory, by P. W. Sheafer, were read; Mr. Lesley exhibited models of the Nittany valley and Bald Eagle mountain, and of the Jones mine, made by Mr. E. B. Harden. Dr. Hunt stated that the iron ore of the Jones and other mines with analogous ores were referable to the horizon of H. D. Rogers' primal slates, though they lie in immediate contact with the Trias. Dr. Frazer said that some of the mines (as at Dillsburg, York Co.) penetrate the Trias, yet the Triassic iron ore deposits may be but the redeposited detritus of more extensive primal slate ores.

May 2.—Mr. Phillips made a communication on a supposed Runic inscription, found upon a rock weighing about 400 pounds, on an island at the mouth of the Tasket river, on the shore of the Bay of Fundy.

May 16.—Prof. Cope described the rich collections of vertebrate fossils in the museums of the City of Mexico. Some species are yet undescribed.

June 20.—Professor Cope read a paper upon the extinct Mammalia of the Valley of Mexico.

July 18.—Dr. Gill's notes on the Stromateidæ were presented for publication, and Professor Cope presented a paper by W. G. Stevenson on a man-eating shark caught off Nantucket.

August 15.—Professor Cope presented a paper upon "The structure of the feet in the extinct Artiodactyla of North America," also a "Fifth contribution to the knowledge of the fauna of the Permian formation of Texas."

ILLINOIS STATE NATURAL HISTORY SOCIETY.—The field and annual meeting was held at Peoria, July 7th. It was intended to combine for this occasion the features of the field and annual meetings, heretofore held separately, the programme of papers and discussions being varied with short excursions for collection and field observation in the vicinity.

The following papers were read: Illinois forests and forestry, by T. J. Burrill; New developments in the Streater coal field, by Edwin Evans; Mastodon and other remains of the loess and drift clays, and their relation to the climatology and geology of the deposits, by William McAdams; Explorations of Indian mounds in Dakota, by William McAdams; Ancient pictographic records on the rocks in the vicinity of the Missouri river, by William McAdams; Experiments with a living copper-head serpent, by William McAdams; Notes on marine algæ, by A. B. Seymour; Recent investigations in relation to the rise of sap in trees, with experiment, by A. B. Seymour; Some corn fungi, by A. B. Seymour; Notes and observations on silk culture, by J. E. Armstrong; On two forms of phytoptus galls on the leaves of *Nyssa multiflora*, by H. Garman; On the artificial production and propagation of insect diseases, by S. A. Forbes; On the fishes of Illinois, by S. A. Forbes. An election of officers was held at which the Hon. William McAdams, of Alton, was made president for the ensuing year, and S. A. Fowler, secretary; Professor Burrill and Mr. J. E. Armstrong were made vice-presidents; Tyler McWhorter was elected treasurer and Dr. Edwin Evans and Mr. A. H. Munelt were chosen as additional members of the Executive Committee.

At an evening session a finely illustrated description of the development of the teeth in man and other vertebrates was given by Dr. Will X. Suddath, of Bloomington, highly interesting to those present, and the president-elect of the society, Mr. McAdams, gave an address on the fossil remains of the bluff clays of the Mississippi river, passing around numerous fossil specimens of the teeth and bones of land animals lately found by him imbedded in nodules in this formation.—*S. A. Forbes, Secretary.*

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